SPECIAL TRADE-SHOW NUMBER

RADIO NEWS

JULY
25 CENTS

Remote Control

The Talkies
and Radio

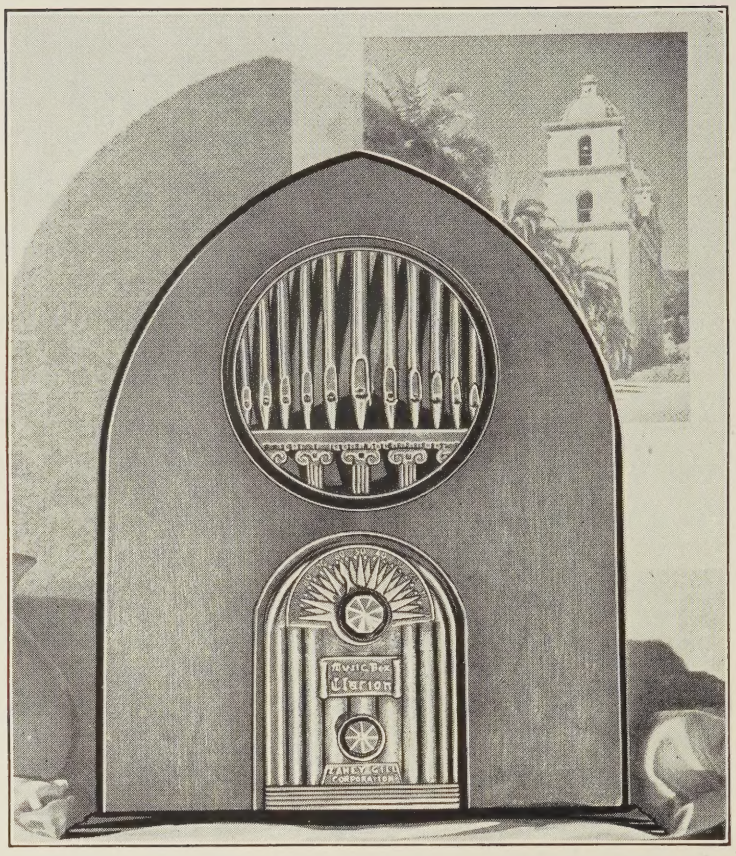
Radio As You Go

Screen Grid

245 Output

Auditorium Volume

Perfect Tone



THE NEW MUSIC BOX CLARION

only

$59.50

Complete with Tubes

Place it where you'd place a clock. Equally beautiful on mantel or table.

Write today for full particulars on this summer business builder.

The Mightiest Midget in Radio

THE FEATURES: A new revolutionary circuit, a sensation in simplicity and efficiency—eliminating 40 per cent. of perishable parts and delivering the output of the ordinary 8-tube set. Here you find Screen-Grid at its greatest advantage—coupled with an exclusive 245 amplification output that delivers unbelievable volume. The other tubes are 227's and a 280 full-wave rectifier.

CHASSIS—Of die cast Duralium; thoroughly shielded—easily accessible—extremely sturdy—assembled by skilled radio technicians; built for hard usage. All parts are oversized, insuring long life.

SPEAKER—Specially designed and matched to this circuit—Tone Quality never before attained except in Super Dynamics. Sturdy, to carry the tremendous 245 output.

TUBES—Only leading brands of licensed tubes used with full replacement service.

THE CABINET—Of solid mahogany with an inch front panel. Size only 14 x 18 x 8 inches. Grill and escutcheon of bronze finish, with a full vision dial reading.

DISTANCE—With a good aerial and ground remarkable distance may be enjoyed. In outlying sections we recommend an aerial of 100 feet or more.

SELECTIVITY--Of unbelievable sharpness from a multi-gang condenser—separating the strongest stations.

ACCESSIBILITY—Chassis may be removed and replaced in five minutes. All parts are accessible to outside adjustment.

THE FACTS: THE MUSIC BOX CLARION was designed to be a high-class midget receiver. It does NOT consist of a large chassis squeezed together, with parts scattered throughout the cabinet. Study the tubes we use—224, 245, 280, 227's. This line-up denotes 1930 design. It means you sell modern merchandise—delivering modern performance. It means long life and economic operation. It means that your contracts are safeguarded. It means that every sale will result in ten others. It means continued business throughout the slump season. The low price of this receiver, coupled with its quality and tone, make it one of the greatest drawing cards of 1930.

Dealers with high priced sets on their floors find these Midgets a remarkable prospect getter. In other words, we have stirred up a dormant field of prospects never before touched. The hotel dweller, the apartment, the small home, the servants' quarters, the office, the cabin, everywhere.

Immediate deliveries to any part of the world. Exclusive franchises being granted. 100 per cent. replacement on defective parts. Just imagine—Screen-Grid, 245 output—TONE—SELECTIVITY—VOLUME—To SELL for only $59.50 with tubes.

THINK! Over 75 per cent. sold for cash in the West. Over 35 per cent. are sold to present Radio Owners. Sell Radios Cash and Carry over the counters. If you don't grab this deal now, your neighborhood dealer will and pick off your prospects. Sell the Public what they want. Write us today!

THE NEW

MUSIC BOX CLARION

Manufactured by the ZANEY-GILL CORPORATION, 5914-5920 South Western Ave., Los Angeles, Cal.

5,000 Radio Service Men Needed Now!

The replacing of the old battery operated receivers with all-electric Radios has created a tremendous country-wide demand for expert Radio Service Men. Thousands of trained men are needed *quick!*

30 Days of R.T.A. Home Training

. . . enables you to cash in on this latest opportunity in Radio

$40 to $100 a week Full Time

$3.00 an hour Spare Time

Ever on the alert for new ways of helping our members make more money out of Radio, the Radio Training Association of America now offers ambitious men an intensified training course in Radio Service Work. By taking this training you can qualify for Radio Service Work in 30 days, earn $3.00 an hour and up, spare time; prepare yourself for full-time work paying $40 to $100 a week.

We furnish you with all the equipment you need to become a Radio Service Man!

More Positions Open Than There Are Trained Men to Fill Them

If you were qualified for Radio Service Work today, we could place you. We can't begin to fill the requests that pour in from great Radio organizations and dealers. Members wanting full-time positions are being placed as soon as they qualify. 5,000 more men are needed *quick!* If you want to get into Radio, earn $3.00 an hour spare time or $40 to $100 a week full time, this R. T. A. training offers you the opportunity of a lifetime.

Radio Service Work a Quick Route to the Big-Pay Radio Positions

Radio Service Work gives you the basic experience you need to qualify for the big $8,000, $10,000 to $25,000 a year Radio positions. Once you get this experience, the whole range of rich opportunities in Radio lies open before you. Training in the Association, starting as a Radio Service Man, is one of the quickest, most profitable ways of qualifying for rapid advancement.

If you want to get out of small-pay, monotonous work and cash in on Radio quick, investigate this R.T.A. training and the rich money-making opportunities it opens up. No special education or electrical experience necessary. The will to succeed is all you need.

Mail Coupon for No-Cost *Training Offer*

Cash in on Radio's latest opportunity! Enroll in the Association. For a limited time we will give to the ambitious man a No-Cost Membership which need not . . . should not. . . cost you a cent. But you must act quickly. Filling out coupon can enable you to cash in on Radio within 30 days, lift you out of the small-pay, no-opportunity rut, into a field where phenomenal earnings await the ambitious. You owe it to yourself to investigate. Fill out coupon NOW for details of No-Cost Membership.

The Radio Training Association of America
4513 Ravenswood Ave. Dept. RN-7, Chicago, Ill.

THE RADIO TRAINING ASSOCIATION OF AMERICA
4513 Ravenswood Ave., Dept RN-7, Chicago, Ill.

Gentlemen: Please send me details of your No-Cost training offer by which I can qualify for Radio Service Work within 30 days. This does not obligate me in any way.

Name .....

Address .....

City ..... *State* .....

Radio News

Vol. XII — CONTENTS FOR JULY, 1930 — No. 1

ALBERT PFALTZ
Associate Editor

ARTHUR H. LYNCH, Editorial Director
JOHN B. BRENNAN, JR.
Managing Editor

EDWARD W. WILBY
Associate Editor

THE predominant note of this, the July issue of RADIO NEWS, is unmistakably of a newsy character. News of the 1930 Trade Show, news of television, news of latest advances in automobile radio, news on remote control systems . . . all the latest up-to-the-minute news which it has been possible to gather.

Continuing this trend the August Issue of RADIO NEWS will be devoted largely to a presentation of information on speech amplifier and public address systems. We have scheduled some highly interesting articles dealing with the various types of speech amplifiers to be had, their installation and special data for the serviceman who has entered the speech amplifier and public address system field.

* * *

Good News for Short-Wave Fans

You remember Fred Schnell, the "ham" who went with the fleet to Australia to demonstrate the practicability of short-wave communication? Well, Fred has designed, especially for RADIO NEWS, a practical, easily built short-wave superheterodyne. The first article of a series on the receiver will be contained in the August issue.

Carl Dreher has provided us with an exceptionally fine article on the technique of sound recording, pointing out the immense importance which radio has played in the phenomenal advancement of this new art. But then what articles of Carl's are not exceptionally fine? Prepare yourself for a typical Dreherian dissertation on radio technique as applied to sound recording.

James Millen and Glenn Browning tell about a new band-pass tuner unit.

* * *

Ralph Batcher gives the technical low-down on dynamic speaker construction, and there are other articles by:

Loftin and White, Hurd, Fleming, Bullock, and other recognized radio authorities.

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Published Monthly by the Experimenter Publications, Inc., at 184-10 Jamaica Ave., Jamaica, N. Y.
Member: Audit Bureau of Circulations

B. A. MACKINNON, President — H. K. FLY, Vice-President and Treasurer

Entered as Second-Class Matter at Jamaica, N. Y., under Act of March 3, 1879.
Executive and Editorial Offices, 381 Fourth Ave., New York, N. Y.

RADIO NEWS is published monthly, on the tenth day of each month preceding that of date. Entered as second-class matter at the postoffice, Jamaica, N. Y., under the act of March 3, 1879. Copyrighted 1930 by Experimenter Publications, Inc.; title registered U. S. Patent Office. Subscription price $3.00 a year; $3.50 in Canada and $4.00 in foreign countries. Single copies, 25 cents each. The contents of RADIO NEWS are indexed in the Industrial Arts Index.

My NEW Book is ready for You

IF you're in Radio now *spare time or full time* – it will show you how my *improved training* can help you make *still more money*

If you're not in Radio / this book will show you how you can get in quickly !

Radio's continued amazing growth and new uses of Radio principles is opening hundreds of fine jobs every year. Broadcasting Stations, Radio Dealers, Jobbers and Manufacturers, Shipping Companies, Aviation, Talking Movies, Research Laboratories and many other sources of good jobs need men well trained in Radio continually. Besides, there are almost unlimited opportunities for a profitable spare time or full time Radio business of your own. Many of my graduates have jumped from $25, $35 and $40 a week to $50, $60, $75 and even $100 a week within a year or less. My book proves this.

I will train you inexpensively at home in your spare time

Hold your job until you are ready for another. Give me part of your spare time. I will give you the training that is raising hundreds of men's salaries every year. I feel so sure that I can satisfy you that I will agree in writing to refund every cent of your tuition fee if you are not satisfied with my Lessons and Instruction Service when you finish my course.

Many make $10 to $30 a week repairing sets in spare time while learning

The day you enroll I will show you how to do ten jobs common in most every neighborhood. Nearly every one of the twelve million Radio sets in use needs $2 to $10 servicing a year. Get some of this money for yourself. I will show you how to do it. I will give you the plans and ideas that are making $200 to $1,000 for many of my students while they are taking my course.

J. E. SMITH, *Pres.*
NATIONAL RADIO INSTITUTE

Before you do anything else Get the dope on my new--

Unique 8 Outfits of Radio parts for a Home Experimental Laboratory giving practical training and experience equal to if not better than most resident courses.

Instruction sheets giving authentic information on servicing many different models and makes of Radio sets. Of great value in spare time and full time service work.

An enlarged and improved course leading to jobs in Broadcasting Stations, Commercial Land Stations, Operating on Board Ship, with Dealers, Jobbers and Manufacturers.

Training in Radio's use in Talking Movie Apparatus, both Vitaphone and Photophone systems.

Training in Television and Home Television experiments.

These are only a few improvements. My book "Rich Rewards in Radio" tells you of many more. Write for it today.

Find out what Radio offers you Get my new free book

It tells you where the good Radio jobs are, what they pay, how you can fit yourself right at home in your spare time to get into Radio. It tells you about the many extra services and materials that the National Radio Institute gives its students and graduates; Lifetime Employment Service and other features. It shows you what others who have taken my course have done — are making—what they think of it. There is no obligation. Send the coupon today.

J. E. Smith, Pres., Dept. OGS
National Radio Institute
Washington, D. C.

Have you read my new book giving an outline of National Radio Institute's improved training in Radio? If you haven't, send for your copy today. No matter what kind of a job you may have in the Radio industry now, unless you are at or near the top, I believe my training can help you get ahead—make still more money—get a still better job. However, I'll let you decide that for yourself after you have read my book—just let me show you what I have to offer. Many others in Radio —amateurs, spare time and full time service men, Radio dealers, fans, custom set builders—have found the way to more profit and more money through this course. You will find letters from them in my book.

See what I offer those who are now or who want to be service men

While my course trains you for all branches of Radio—I am also giving extensive, thorough and practical information on servicing different models and makes of A.C., D.C., battery operated and screen grid tube sets. Atwater Kent models, Crosley, Zenith, Majestic, Stewart-Warner, Radiola, Eveready, and many other makes are covered. This information is of special help—of real money-making value—to those who are now service men or those who want to be service men. This part of my training, however, is only one of 18 features that I am offering men and young men who want to get good jobs in the Radio industry —or who are in Radio and want to advance. Even though you may have received information on my course before, unless you have gotten my new book as pictured above, write to me again—see how N. R. I. has grown and improved, too. While my training has been enlarged and revised—my course is not new or untried. Hundreds of men in Radio owe their success and larger income to it. Send the coupon today.

CLIP AND MAIL THIS *Coupon* DO IT TODAY

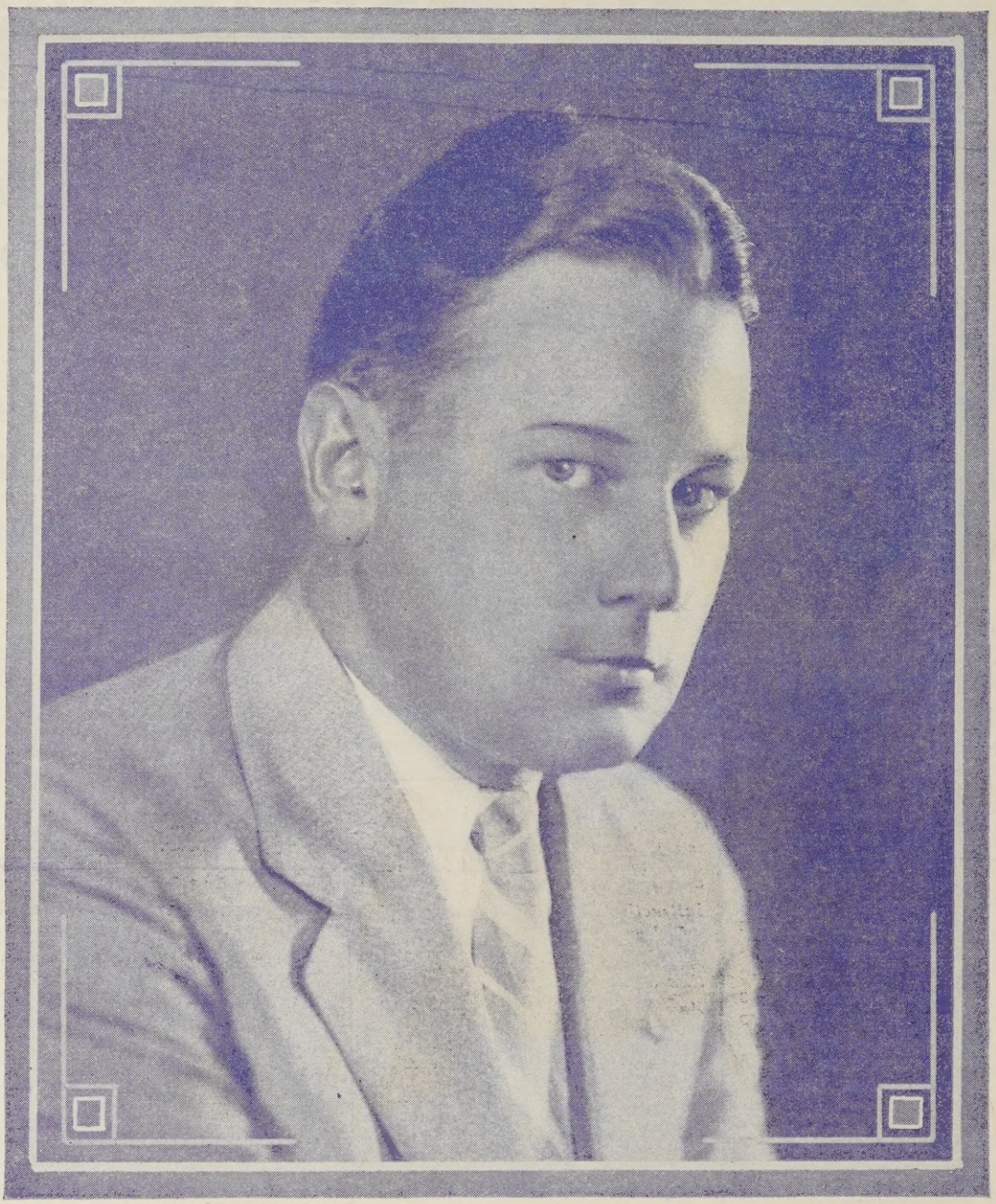
J. E. SMITH, President
National Radio Institute, Dept. O G S
Washington, D. C.

Dear Mr. Smith: Send me your book "Rich Rewards in Radio." I want the facts on the opportunities in Radio and your revised and improved course. I understand this does not obligate me and that no agent will call.

Name .....

Address .....

City ..... State .....



G. Clayton Irwin, Jr.

The militant motivating personality behind the Radio Manufacturers' Association Shows. Essentially a salesman with a great sense of showmanship in publicity, Irwin is to be found pulling many of the strings which make the man-in-the-street stop and look at radio. The Radio Trade Show at Atlantic City and the New York Radio World's Fair, as well as the Chicago Radio Show, are under his direction. Mr. Irwin originated the *Brooklyn Daily Eagle's* radio department and later was associated with the Conde Nast Publications. He is doing an exceptional job for all of us and, incidentally, is being fairly well paid for his trouble

DATE SOLD

SELLING CHAMPION RADIO TUBES JOINS WITH CHAMPION RADIO WKS. INC IN GUARANTEEING THEIR PERFECTION FOR

MERCHANTS SELLING CHAMPION TUBES

NINETY DAYS AND WILL REPLACE PROVIDING DATE OF SALE APPEARS ON THIS LABEL

Now! Ribbon Labels for Dating!

Champion

Sturdiest Construction Gives Longer Tube Life.

Champion

Boxed so you can see what you buy . . .

Champion

You Can Test Every Tube Without Removing it from the Individual Carton.

Champion

Every Tube Guaranteed Completely Non-microphonic.

Now Champions offer the radio set owner PROOF of their extremely long lives. Every single tube that leaves the giant Champion factories is now RIBBON LABELED for Dating by the dealer when the tube is sold.

Thus, profits on additional sales take the place of replacements and satisfy set owner, retailer and jobber of the fair value received and delivered.

Dealers will particularly appreciate the RIBBON LABEL for Dating. Its date—clearly marked—absolutely eliminates costly and annoying arguments over replacements.

Servicemen, too, are assured of less trouble. First, because these tubes are so consistently satisfactory. Second, because the serviceman's arguments over guarantees are eliminated.

Champion Radio Works, Inc.
1136-1143 Pine Street Danvers, Mass.

Champion
RADIO TUBES

DATE SOLD

SELLING CHAMPION RADIO TUBES JOINS WITH CHAMPION RADIO WKS. INC IN GUARANTEEING THEIR PERFECTION FOR

MERCHANTS SELLING CHAMPION TUBES

NINETY DAYS AND WILL REPLACE PROVIDING DATE OF SALE APPEARS ON THIS LABEL

The Radio Trade Show

MANY of us have heard of the Radio Trade Show which takes place in June each year and for the past few years has been held in Chicago. This year Atlantic City has been chosen as the site of the convention. We know many of the manufacturers and many of the dealers interested in radio who find their way to this show and, from the reports we get on their return, they have a perfectly delightful time. In fact, if we did not know that this was a dry country, we might imagine from some of the reports that hard liquor was still available.

Entirely aside from the tremendous ballyhoo which this show receives and the good time had by all, there is a very interesting and serious side of the show activity—one of tremendous benefit.

The show is not open to the public. It has been designed to enable manufacturers to display advance models of their newest productions to the jobbers and dealers throughout the country. The show costs millions of dollars but it saves the radio manufacturers many more millions by making it possible for dealers throughout the country to be visited within less than a week. Many of the most progressive dealers find it to their advantage to know at first hand what the important manufacturers are going to offer the public.

The public is not permitted to attend this show, the reason being not that the manufacturers do not want the public to be entirely familiar with what they are going to offer, but to enable the manufacturers themselves to conserve their energies in presenting their case to the greatest number of people directly interested in the sale of their merchandise. For the first time since the Radio Show has been in existence the public is to be permitted to have a look in this year. By special arrangement with most of the leading manufacturers it has been possible for RADIO NEWS to secure advance information concerning the important developments which have appeared at the Show. These developments, aside from the actual improvement in broadcast receiving equipment, are found in four outstanding and equally interesting successes.

The first is one very dear to our hearts, because we have done a great deal of real pioneering in it; namely, automobile radio. We are convinced that before the summer is over more than a million automobiles will be equipped with radio receivers. This means that in addition to presenting a new type of enjoyment to more than a million families, RADIO NEWS has been directly responsible for the production of at least 75 million dollars' worth of summertime radio business. This business is of great benefit to many manufacturers who, up to now, have not had a part of the radio business at all.

The second important development which the Trade Show has brought out is the practical television equipment now being offered for sale by several reputable manufacturing concerns. It is very gratifying to find in connection with this television advance that the manufacturers themselves are keenly interested in preventing the publication of any exaggerated claims for present-day television reception. They believe that the art will progress very much more rapidly if the public is not led to expect too much.

The third interesting development which the Show has brought forth is a great group of practical remote-control devices. This subject is so completely covered in other pages of this issue that there is no need for amplification of it here.

The fourth interesting subject is the pentode and other new tubes. Our stand in connection with the pentode was very definitely delineated a few months ago. We said, at that time, that the pentodes were logical tubes and should be used. A great deal of experimental work has been done with them since they were, like television, inopportunely announced, and it is quite logical that before the end of this season we will see quite a number of satisfactory receivers in which pentodes are employed.

However, we believe the new receivers, incorporating the new tubes, designed for low filament consumption, are more interesting for the immediate present.

From what has been seen at the Trade Show, 1930-31 is unquestionably to be the greatest year radio has ever seen, both from the viewpoint of those in the radio industry and the consumer public.

Arthur H. Lynch

R. T. I. R. T. I. QUALIFIES YOU TO MAKE MONEY AND ITS SERVICE KEEPS YOU UP-TO-THE-MINUTE ON THE NEWEST DEVELOPMENTS IN RADIO, TELEVISION, AND TALKING PICTURES **R. T. I.**

RADIO TELEVISION-TALKING PICTURES

TUNE IN ON R·T·I.

BIG MONEY NOW!

More to Come

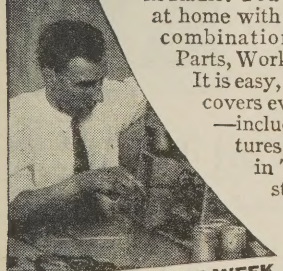
Radio now offers ambitious men the greatest Money-Making Opportunity the world has ever seen! Hundreds of trained service men are needed by radio dealers, jobbers, and manufacturers!

A "trained" Radio "Service and Repair" man can easily make $40 to $50 a week, and it's very common for a "trained" man with experience to make $75 a week, and up.

BIG MONEY for Spare-Time Radio Work is easily made in every city and village. You can now qualify for this Big-Money work quickly through R. T. I. Get the Big Money Now and go up and up in this Big Pay field. The Radio industry calls for More Men, and R. T. I. supplies what the industry wants you to know.

Supervised by Radio Leaders

R. T. I. training is prepared and supervised by prominent men in radio, television and talking picture engineering; distributing; sales; manufacturing; broadcasting, etc. These men know what you must know to make money in Radio. You learn easily in spare time at home with the R. T. I. wonderful combination of Testing Outfits, Parts, Work Sheets, Job Tickets, It is easy, quick and practical, covers everything in Radio —includes Talking Pictures and the latest in Television. Get started in Big Money Radio work now.



$60-$70-$80-PER WEEK AND UP. That's what R. T. I. training leads to. Send for the R. T. I. Book and see for yourself.

No Experience Needed

ALL YOU NEED is ambition and the ability to read and write. The Radio industry needs practical trained men. Remember, R. T. I. makes it easy to earn spare time money while you learn at home.

More to come

THE MEN who get into this Big-Money field now will have an unlimited future. Why? Because this billion dollar Radio industry is only a few years old and is growing by leaps and bounds. Get in and grow with it. $10 to $25 per week and more is easily made in spare hours while you are preparing for Big Money. TELEVISION, too, will soon be on the market, so the leaders say. Be ready for this amazing new money-making field. Remember, R. T. I. "3 in 1" home-training gives you all the developments in Television and Talking Picture Equipment, together with the complete Radio Training.

Warning

Do not start R. T. I. training if you are going to be satisfied to make $15 or $20 per week more than you are now. Most R. T. I. men will make that much increase after a few weeks. There is no reason to stop short of the Big Money Jobs or the Big Profits in a spare time or full time business of your own. No capital needed. Get started with R. T. I. now. Make money while you learn at home.

R. T. I. Book Now FREE

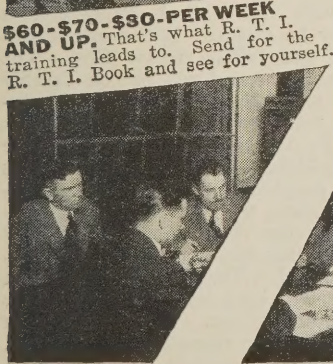
The thrilling story of Radio, Television and Talking Pictures is told with hundreds of pictures and facts — its hundreds of big money jobs and spare time money-making opportunities everywhere. Send for your copy now. USE THE COUPON.

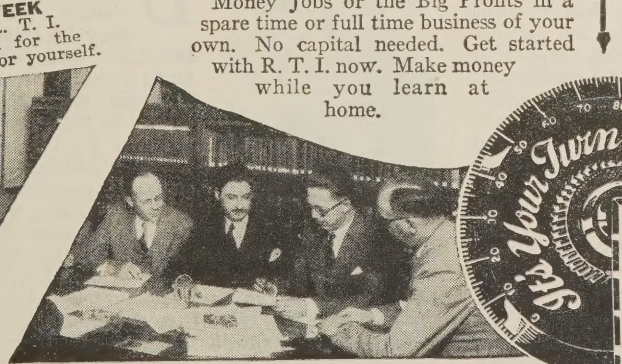
LET F. H. SCHNELL AND R. T. I. ADVISORY BOARD HELP YOU

Mr. Schnell, Chief of the R. T. I. Staff, is one of the ablest and best known radio men in America. He has twenty years of Radio experience. First to establish two-way amateur communication with Europe.

Former traffic manager of American Radio Relay League, Lieutenant Commander of the U. S. N. R. Inventor and designer of Radio apparatus. Consultant Engineer to large Radio manufacturers.

Assisting him is the R. T. I. Advisory Board composed of men prominent in the Radio industry.





THE R.T.I. ADVISORY BOARD. These men are executives with important concerns in the radio industry—manufacturing, sales, service, broadcasting, engineering, etc., etc. They supervise R. T. I. Work Sheets, Job Tickets, and other training methods.

R. T. I. R. T. I. TRAINS YOU AT HOME FOR A GOOD JOB OR A PROFITABLE PART TIME OR FULL TIME BUSINESS OF YOUR OWN

RADIO & TELEVISION INSTITUTE
Dept. 84-B, 4806 St. Anthony Ct., Chicago

RADIO & TELEVISION INSTITUTE
Dept. 84-B, 4806 St. Anthony Court, Chicago

Send me Free and prepaid your BIG BOOK "Tune In On Big Pay" and full details of your three-in-one Home Training (without obligating me in any way).

Name.....

Address.....

City..... State.....

1930 As Radio

By H. B. Richmond

President, Radio Manufacturers' Association, Inc.

THE reduction in the number of receiver manufacturers has enabled the survivors to pick their distribution outlets more carefully than has ever before been possible. This is resulting in a distribution efficiency comparable with the increase in manufacturing efficiency. The purchaser of radio receivers may well look forward to receiving an even increased value from his radio dollar.

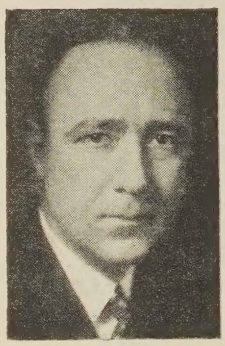
With continuous improvement in broadcast programs, with the extension of receivers into several rooms of the house, and with improved values in the receivers themselves, the whole radio industry is well justified in the confidence it is placing in its next radio season.

By Powel Crosley, Jr.

President, Crosley Radio Corporation

SO far as we are concerned, business is back to normal and steadily improving. Our sales are now greater than for the same period last year, when we had the largest business in our history. New items have been added to our line that should substantially increase our business for the remainder of the year. Both engineering and merchandising have been carefully planned. Production on our new auto receiving set is being increased and it promises to be one of the biggest sellers in our line. The radio industry should have a good year and will be especially satisfactory to the manufacturers that provide attractive, well-made merchandise at prices people can afford to pay. We are facing the future with great optimism.

By Merlin H. Aylesworth



President, National Broadcasting Co.

IF radio may be considered a significant index of general industrial conditions, continued progress in the speedy resumption of the normal pace of all business may be expected. The National Broadcasting Company is doing more business today than a year or six months ago. New contracts, renewals and options for 1930 assure a continuance of substantial increases in business during the year. American industries are presenting more and better radio programs to an ever-growing audience.

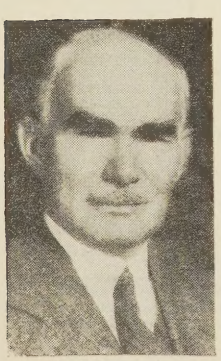
In 1929 approximately 4,500,000 radio sets and 69,000,000 tubes were sold. Most of the receivers sold were of the high-grade, electrically operated type. The first three months of 1930 indicate that more than 5,000,000 sets will be sold this year, representing a substantial increase over last. At least 84,000,000 tubes will be purchased, an increase of 15,000,000 over 1929. Rapid developments in radio broadcasting technique, and competition between sponsors of radio programs are creating increased demands for modern radio receivers and speakers. In so far as radio is concerned, prospects for 1930 are good.

By McMurdo Silver

President, Silver-Marshall, Inc.

THE radio industry has been through an elimination period—leaving fewer but stronger manufacturers and dealers to supply a steadily increasing consumer demand. Dealers can buy with confidence that few changes will be made during the coming season. Manufacturers whose lines they carry have survived the severest test of competition and finance. Consumers can rest assured that the aggressive merchant from whom they buy a set will be in business months later to back up his service guarantees.

By Dr. Lee De Forest



Consulting Engineer and Inventor

REFINEMENTS, rather than startling innovations, should be the keynote of radio progress during the coming year. In tubes, circuits and broadcasting, we have an ample foundation upon which to build. Yet those essentials, when critically examined, leave much to be desired by way of refinement. Thus radio tubes may be and, in a few instances, are being refined in mechanical and electrical design. The day is rapidly dawning when the public, fully appreciative of the part played by tubes in their radio entertainment, will employ none but the best. In circuits, we have further opportunities for refinement, without gambling time and effort in search of the theoretical last word. In broadcasting, it becomes increasingly obvious that the entire radio industry rests on the merits of the broadcast programs, which in turn depend on the finesse with which the advertising appeal is handled. Unless program sponsors come to appreciate full well their status as invited guests rather than advertising sandwich men in the average home living room, we may well question the security of the future radio industry.

By Carl Dreher

Chief Sound Engineer, RKO

DURING the next year notable, although not radical, improvements may be expected in the speech amplification and talking movie field. The audio-frequency band will be considerably extended, especially on the high end, resulting in more natural reproduction of lip sounds. In talking movie recording the tendency will be to remove the microphones as far as possible from the immediate vicinity of action, thus speeding up production and giving the actors more leeway for dramatic effects. Better microphones and anti-ground noise recording methods are being developed. These improvements in sound recording and reproduction will keep pace with the wider picture, development of color processes, etc. Improvements in sound gate design will result in smoother reproduction of music. Low-grade reproducing equipment in theatres will be largely supplanted by high-quality apparatus. There is reason to believe that in time electrically reproduced drama will be preferred to the original, through improvements in the mechanical medium which will render it entirely unobtrusive, while enabling it to transcend the limitations of the unaided human voice and senses.

Leaders See It

By Ernest Kauer

President, Ceco Manufacturing Company

THE forthcoming radio season, ushered in by the Annual Radio Trade Show at Atlantic City in June, holds promise of being the most satisfactory to the public of any season since broadcasting began.

There are several reasons. First, broadcasting itself has set a new standard of quality in the season now coming to a close, and this will be enhanced in the new season. Radio manufacturers have done much to contribute to improved programs and will do more.

Quality of merchandise is better than ever before. There is an honesty in manufacture that is indisputable; the only limitations that exist in quality today are those of human frailty, and production experts are gradually eliminating these. The distributing field is cleaner than ever before. Unethical and weak manufacturers have been forced out to a great degree by last season's stringencies.

By and large, the outlook is exceedingly happy. The public will hear better programs and buy better radio products at no greater, possibly less, cost.

By J. E. Smith

President, National Radio Institute

THE importance of radio servicing as a factor in radio merchandising cannot be overstressed. A set which does not perform 100% satisfactorily gives both the dealer and the manufacturer a black eye. Manufacturers realize this—and dealers are just beginning to. This year will see the position of the serviceman as a link in the chain—manufacturer, jobber, dealer, serviceman—strengthened materially. The progressive dealer is learning that cheap help doesn't pay. Consequently the demand for properly trained and equipped servicemen is growing—exponentially—in proportion to the growth of wisdom on the part of employers of servicemen.

By C. C. Colby

President, Samson Electric Company

IN the sound projection field the year 1930 opened with business slack as a reaction from the stock market collapse of the late fall. Since February, however, there has been a continuous improvement, with indications that by the middle of the year normal conditions will have returned.

There has been no distressed merchandise in this field, no companies in trouble, and the drop in the merchandising curve has been due largely to the generally unsettled financial condition of the country. Confidence is coming back, and, coupled with an ever-increasing interest and widening field, I look for excellent business during the latter half of the year.

By George Lewis

Vice-President, Arcturus Radio Tube Co.

IT is quite possible that an improvement in radio receivers may be effected with a modification of existing tube types. While such a change will not necessarily lessen the utility of our present sets, the purchaser will receive greater radio value for his money.

Further developments along the lines of remote control are inevitable in this era of labor-saving devices. The receiver that will find the most ready market is the set that best adapts itself to that after-dinner indolence—when programs are at their best and the inclination to move at its lowest ebb.

Automatic volume control will add consistency and enjoyment in the reception of distant stations with still more receivers. And I anticipate the design of one or more manual volume control systems that will control intensity of signals with absolutely no effect on quality (within the limits of permissible tube and speaker loads).

And it seems logical to look for a radio, phonograph and home movie combination in the more elaborate layouts, utilizing, of course, the common audio amplifying system.

By Robert Hertzberg

Pilot Radio & Tube Corporation

AS a hobby for the experimenter and dabbler the short waves have almost entirely supplanted regular broadcasting. Thousands of former set constructors and DX "fans," who dropped the radio game simply because they had exhausted the possibilities of the 200 to 550-meter channels, are learning of the thrills that await them on the high frequencies; and they are buying apparatus, building sets and twisting dials with that burning spirit of enthusiasm of old. The incipient short-wave boom will undoubtedly break with full force during the coming season, and the parts and kit manufacturer who prepares for it will enjoy a rousing revival of business.

By R. H. Marriott

Consulting Engineer

I EXPECT: less receivers for the industry and more for the listeners; more radio development by the Radio Manufacturers' Association, the Institute of Radio Engineers, *et al.;* the Commission, supervisors and broadcasters to continue to reduce squeals and improve radio generally; band-pass receivers to reduce cross-talk; direct-coupled amplifiers to improve quality and prices; better speakers; more dependable tubes; more radio power to override static; more radio aids for aviation; better television pictures; better international broadcasts; more world-wide telephone and telegraph services; more receiver salesmen like Amos, Andy, and Will Rogers; and improvements I do not expect.

By Ray H. Manson

Vice-President and Chief Engineer, Stromberg-Carlson Mfg. Co.

THE outlook for the coming radio year is encouraging, as many valuable lessons have been learned from the strenuous experiences of last season. The trend of new receiver designs is directed towards better performance, particularly the making of the complete tuning range of the receiver of equal value as regards selectivity, sensitivity and uniformity in audio quality. Heretofore, high selectivity has been obtained at the expense of good audio quality, especially at the low frequency end of the tuning dial. These improvements in performance are certain to build up increased customer demand for new radios.

By Edward H. Loftin

Radio Engineer

NOW that radio has definitely become as much an established institution in the home as the daily newspaper, the need for 15,000,000 or more radio sets to complete the now practically assured radio in the home program of this country alone promises much for the coming season's radio business. Even a mere beginning at the tapping of this enormous residual market will provide a most substantial year's business. I caution, however, that the complete working of this beckoning residual radio market will be accelerated by considerably reduced prices for good radios with fewer expensive tubes over those prices heretofore prevailing.

By Sam Pickard

Vice-President, Columbia Broadcasting System

PROGRESS in the past year, both in laboratory and sales development has been so marked that should the present pace be maintained, observers should see the most unusual and fruitful year the industry has experienced.

The idea that the summer months bring stagnation is exploded. The country's foremost advertisers are realizing the merits of the vacation period and are expanding accordingly. We approach the coming months optimistically and enthusiastically.

Closely approaching the billion-dollar class, 1929 gave radio sixth place in the country's major industrial field.

The photo-electric cell, aided by the neon tube and scanning disc, has brought what is destined to be the greatest achievement of our age—a definite prediction of television. Although all its problems have not been solved, it is safe to say that engineers now have it well in hand.

During the past twelve months the Columbia Broadcasting System network has grown from a group of 46 stations to a total of 74. The West coast and South have been tied in on a permanent wire basis.

The quality of programs and the number of commercial sponsors have increased in approximately the same ratio as the growth of the network. Although no definite check has been made on the number of listeners as compared with a year ago, it is safe to assume, based on the tremendous volume of receiving sets sold, that a majority of the American public now listen to radio programs.

By Samuel Egert

Wireless Egert Engineering Company, Inc.

THIS season, those connected with both radio and automotive industries have an entirely new market at their disposal—namely, the automobile radio. Its success depends upon those connected with its manufacture, distribution and installation. Our modern methods of manufacture and distribution can easily rise with this new demand, but its ultimate success is dependent upon the rapidity, ease and correctness of its installation. Once the serviceman masters the obstacles which automobile radio creates, and produces the satisfied customer, the possibilities of this field become unlimited. It would be to the advantage of every serviceman in the United States to study every bit of available data on auto radio. Different cars present different problems of mechanical and electrical kinks which can be ironed out by experience. Remember, the car owner will not stand for any tampering with the efficiency of his motor. Give him a quick and clean installation and he will bring more customers.

Automobile radio has forged ahead with such rapid strides as to have incurred the wrath of what I believe to be ill-advised legislators in several states of the Union. It was only after those people responsible for the pioneer work in this field attended several legislative hearings and presented automobile radio in its true light that the opposition by uninformed people was effectively combatted.

Radio, if nothing else, is a boon to automobile driving in that it has a tendency to reduce speeding, relieves driving fatigue, fills the long, lonely hours of driving with an unobtrusive diversion of the auditory variety and in no way adversely affecting the proper operation of the car.

Auto radio is here and here to stay.

By R. L. Duncan

President, RCA Institutes

IT is not so much the producing and merchandising of a million or more sets that presents the greatest problem during the forthcoming year. Actually, it is the servicing of the ten or twelve million radio sets already in the hands of the public. After all, the radio set is bought for just one purpose: radio entertainment. Upon the maintenance of an endless flow of radio programs, through the proper functioning of the radio set, rests the future success or failure of any radio manufacturer. That the grave problem is fully appreciated is evident from the growing demand for trained radio men. No longer is the industry interested in the erstwhile handy man, working with pliers, screwdriver and soldering iron. Today the industry seeks the man with sound training, equipped with remarkable testing equipment, and possessing a convincing personality. It is in order to provide the men of proper training that radio training facilities—resident courses and correspondence courses alike—are being expanded as never before to take care of the steadily growing army of radio students.

By Allen B. Du Mont

Chief Engineer, De Forest Radio Company

POPULAR interest in short-wave radio is everywhere evidenced. That great army of "pioneering adventurers" who played such an important part in the development of radio broadcasting is now turning to the lure of listening to distant lands and the fascination of watching television programs in the home.

In spite of the usual pessimistic propaganda that always precedes the advent of a new era or a new development, television has reached the stage where it has demonstrated its readiness for home enjoyment.

The American public is manifesting its interest in keeping pace with this new art and many homes are now watching television programs regularly, preferring to believe their own eyes rather than be guided by the "it's-not-ready-yet" pessimism of a few engineers.

By A. A. Leonard

Chief Engineer, Automobile Radio Corp.

MY first ride in a radio-equipped automobile occurred more than four years ago. The equipment was necessarily crude as at that time auto radio was still in the development stage. The impressions of that ride are still vivid, however, and it served to demonstrate that auto radio is the greatest contribution to domestic life since the advent of broadcasting.

The development of a radio receiver for motor-car installation has taken much time and effort. The results are most gratifying to those whose foresight prompted its undertaking. The past four years have demonstrated the utility, dependability of the automobile receiver and the combination of these two great factors of modern life has met with immediate acceptance and appreciation by car owners throughout the country.

A radio receiving set will soon become a necessary part of the equipment of every automobile.

By James Millen

General Manager and Chief Engineer, National Company

THE enthusiastic response of the motoring public to automobile radio indicates that such equipment fills a recognized want. I feel that the buying public has tested and approved the new experience of entertainment on the open road. It appeals alike to those who travel extensively alone, to those who wish to follow their favorite programs while away from home, and to those who take pride in the appointments of a fine car.

Automobile radio is well past the experimental stage, and the problems which vex the designer of such specialized equipment are rapidly yielding to intensive research in the laboratory and the field. This embryo field will undoubtedly become an important factor in summer radio sales, even this year.

By Arthur Moss

President, Electrad, Inc.

RADIO principles are so far-reaching only a modern Solomon would dare predict a limit. New developments come so fast they have already outgrown the boundaries of the so-called radio industry.

Today, it is a topic of universal interest—or should be.

The development of the vacuum tube has opened up entirely new fields. Recently a new magazine was announced which will be devoted entirely to uses and adaptations of tubes to industry.

Just stop and consider a few of the fields aided by the use of the tubes such as those of communications, medicine, lighting, aviation, mining, television and many others. Regardless of what the industry may be, a basic knowledge of the principles of radio will be of great value to the boy or girl who anticipates entering the world of industry. Perhaps the best way to secure this knowledge is to adopt radio as a hobby when one is young. In this manner training can be secured without drudgery.

It is our belief that every man, woman, boy and girl, to keep abreast of the age in which he or she lives, should know something about radio—not its technical phases necessarily, but its broader aspects as they relate to the future comfort and progress of mankind. Radio no longer is merely a vehicle of communication or entertainment; it bids fair soon to attain a usefulness second only to electricity itself.

By Harold L. Olesen

Electrical Engineer, Jewell Electrical Instrument Company

THE tendency during the past years has very definitely been for better testing equipment for both factory and service use. The ever increasing demand for better radio sets has necessitated the use of better factory testing equipment. This same demand is now being felt in the service field for better service, with the result that the various service organizations, whether independent or under the guidance of some radio set manufacturer, are finding a pressing need for good service equipment.

This need for better service equipment is being answered by the manufacturers of such apparatus, with the result that a very satisfactory season is before both the serviceman and the manufacturer of his equipment.

By Lloyd Hammarlund

The Hammarlund Manufacturing Company, Inc.

THE industry faces a very hopeful condition. Even though general business conditions are not as bright as last year, radio conditions are very much better.

Manufacturing and selling programs will be more conservative this year. The broadcast listener will have still better programs and reception. The radio buyer will receive more for his money than ever before, because of tremendous engineering advancements and keen competition.

Although it is usually customary to predict the future with greater degree of optimism than is warranted by conditions existing at the time, I can sincerely state that the coming radio year should be one of better business for the industry in general and hold far greater degree of satisfaction for radio builders and users.

By B. F. Dulweber

President, Supreme Instruments Corp.

DESPITE the decline in volume of sales in the radio industry during the past seven or eight months, the sale of testing equipment has shown a marked increase. That the sale of such equipment should have increased during the period when the industry as a whole has been so greatly depressed is indicative of the ever increasing realization that service is the "bed rock" upon which the successful merchandising of receiving sets must be built.

The radio public is becoming better informed, more critical and more exacting in its demands and the growth of the individual business as well as that of the industry collectively depends upon satisfying that demand and delivering the consistent pleasurable results that can be obtained from the present-day receiving sets—that means adequate, efficient, consistent service. Dealers and servicemen, in constantly increasing numbers, are learning through actual experience that the type of service that builds permanent business success can be performed at a negligible cost through the use of efficient, well designed testing equipment. To this may be attributed the increased sales of such equipment during the recent period of general recession and a continued increase during the coming year may be confidently expected.

Dealers and servicemen during the past year have selected servicing equipment with greater care and intelligence. This more critical selection will continue and grow in intensity and the trade will insist upon properly designed and constructed equipment, possessing such range and elasticity as will adequately meet every servicing need.

The Pilot plane in Hamilton harbor

W2XBQ Flies to

The Pilot Flying Laboratory Makes Flight to the Summer Isles. Two-way Throughout the Flight Between the Plane New York "Times." The Operator and the High Spots

By Zeh

Zeh Bouck at the transmitter aboard the plane. At the right is a close-up of the wind-driven generator mounted on the side of the ship

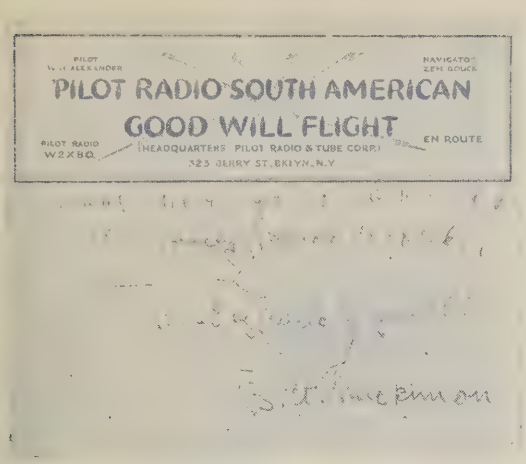
ONE of the primary objects in the promotion of the recent flight to Bermuda was to determine the extent to which reliable communication with land might be maintained on an over-ocean flight. And when I write "reliable communication," I refer to a continuous interchange of messages between the plane and land, comparable to the traffic handled by an ocean liner. That this object was achieved is demonstrated in the fact that while over fifty messages were handled, back and forth, between WHD, the radio station of the New York *Times*, and W2XBQ, the airplane "Pilot Radio," not a repeat of a single word was requested. The signals received on plane and land suffered from practically no diminution throughout the eight-hundred-mile flight. One of the last messages transmitted from New York, just before the plane alighted in Murray's anchorage, Bermuda, was to the effect that the signals were every bit as consistent and powerful as when we took our departure from Scotland lightship the day before. As for WHD's signals, due to their painful loudness it was actually necessary to detune the receiver from their wave.

Transmitter and Receiver Design—The transmitter and receiver were built in the laboratories of the Pilot Radio and Tube Corporation, sponsors of the flight—and the plane used in the flight was their flying laboratory. The problems confronting us were those of electrical efficiency, weight and space. Electrical efficiency considered several aspects, including the ability to transmit and receive over long distances, and the necessity, from the point of view of safety, of being able to operate for a reasonable period of time from the surface of the sea. The problem of weight is omnipresent in designing aircraft radio equipment, and was considered by the writer in some detail in his article, "The Problems of Aircraft Radio," appearing in RADIO NEWS for July, 1929. Space was a matter of convenience and comfort, and was both psychological and physical. A comfortable radio shack is almost essential to efficient operating.

The Transmitter—Two transmitters, combined in one unit, were carried, covering both long and short waves, the long-wave transmitter being effective between 600 and 1100 meters and the short-wave transmitter covering a band from 35 meters to 50 meters. Changing from long to short waves was accomplished by switching over inductors, the same tube and meter combinations being employed on all wavelengths. In addition, an exterior loading coil was used for transmitting wavelengths above 700 meters. A Hartley oscillator was employed in both transmitters.

The Receiver—The receiver was mounted on a sliding shelf below the transmitter, both receiver and transmitter being combined in a single suspended unit. The receiver was mounted below the transmitter in order to provide the greatest possible isolation of the short-wave transmitter, and slides in and out on its shelf to facilitate changing coils. The receiver is a modification of the Pilot a.c. Super-Wasp, described in the

*Managing Editor, Aero News and Mechanics; Engineer in charge of Aeronautics, Pilot Radio & Tube Corp.



Above is a view of the *New York Times* radio room, with Fred E. Meinholtz, at the left, and R. J. Iverson. The Pilot plane was in constant communication with the *New York Times* short-wave station, WHD

Bermuda

Radio and Aviation History in an Epic Communication Was Maintained and WHD, the Short-Wave Station of the Describes the Plane's Radio Equipment of the Flight

Bouck*

January issue of RADIO NEWS by Robert Hertzberg.

A.c. tubes, operated in series through a suitable resistor, were employed in preference to the d.c. type in view of the lowered microphonic response. Special coils were wound, giving a tuning range of from 14 to 1200 meters.

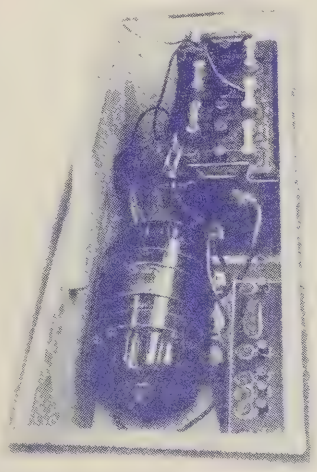
Power for all filaments is supplied from an Exide non-spillable twelve-volt aircraft battery, which also turned over the Esco dynamotor feeding the De Forest 510A transmitting tube with 100 milliamperes at 1,000 volts. The storage battery was charged continuously during flight (except during reception) by an Esco wind-driven generator driven by a Deslauriers one-blade constant-speed propeller.

With this power combination, and an emergency antenna, about ten hours of average communication is possible when down on water or land.

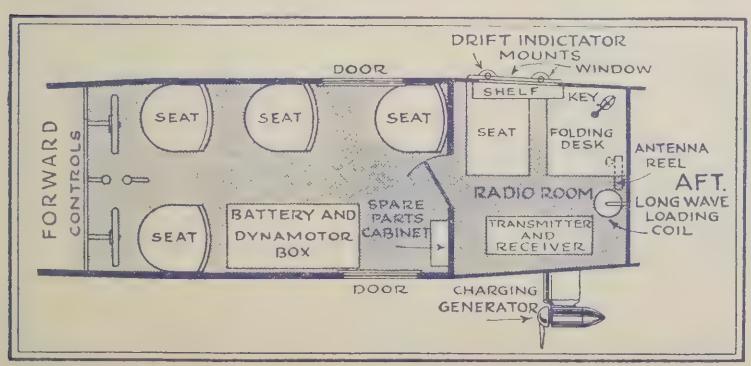
A convenient switch disconnected the generator, eliminating commutator interference during reception. A send-receive switch on the radio panel controlled the filament and dynamotor, transferred the antenna from the transmitter to receiver and disconnected the plate voltage from the receiver during transmission. A separate filament switch made it possible to burn the receiving filament while transmitting, eliminating the heating lag. The plate voltage to the receiver was supplied by the special Eveready aircraft unit "B" and "C" battery.

A trailing wire antenna was employed, measured lengths being indicated on the wire for different frequencies. The transmitter was operated, during the Bermuda flight, on 41 meters, the antenna being about ninety feet long and working on the third harmonic. This resulted in stable functioning of the oscillator (somewhat unreliable on the fundamental with close coupling) and provided a highly satisfactory pick-up when receiving.

The General Layout—The arrangement of the radio cabin is shown in the accompanying drawing, and considers the convenience and comfort of the operator. There is plenty of legroom under the folding desk, the key is located for comfortable operating, and all controls are at the fingertips of the operator. The cabin is well lighted with a window at the operator's left. There is no loose equipment. All spare parts are carried in closed shelves, and the entire layout is one that lends itself to electrical and mental efficiency.



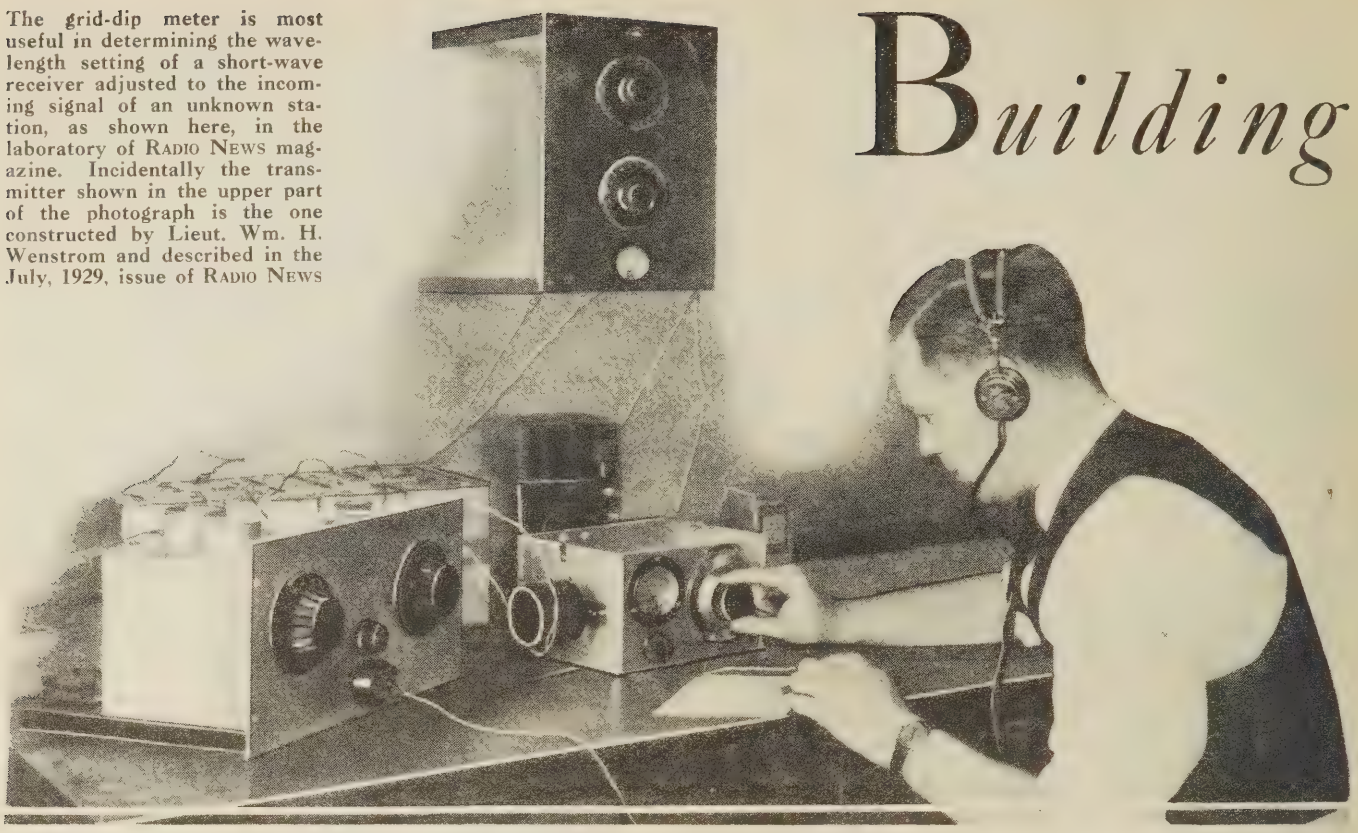
Above is a view of the dynamotor driven by the storage battery. The wind-driven generator keeps the battery at a constant charge when the ship is in flight. At the left is a diagram of the plane interior, showing the location of the radio room and apparatus



The Flight—On the morning of April the first, with W. H. (Bill) Alexander at the controls, and Captain Lewis A. Yancey, our navigator, alongside of him, we taxied across Flushing Bay to Classon Point for our first attempt at a take-off. Our first four efforts were failures. There was practically no wind, and the Sound was almost without a ripple. Under these circumstances it is next to impossible to break the suction under the pontoons and take off a heavily loaded plane. Between attempts we lightened the ship by draining gas and discarding our anchor and kit of spare pontoon plates. Just before our fifth attempt a slight wind arose. We waited until two ferry boats crossed in front of us, to take advantage of the waves created in the wake, and Bill Alexander gave her the gun. As she gained speed, George Post in his *Travel-Air* taxied across our path, wide open, throwing up a choppy sea that helped

(*Continued on page* 72)

Building



The grid-dip meter is most useful in determining the wavelength setting of a short-wave receiver adjusted to the incoming signal of an unknown station, as shown here, in the laboratory of RADIO NEWS magazine. Incidentally the transmitter shown in the upper part of the photograph is the one constructed by Lieut. Wm. H. Wenstrom and described in the July, 1929, issue of RADIO NEWS

PROBABLY no other piece of laboratory apparatus is called upon in conducting an experiment, in calibrating a receiver or clicking out a coil-condenser combination more than the wavemeter. Truly it may be said that the wavemeter is to the experimenter what the slide-rule is to the engineer.

To begin to set down the many uses of the wavemeter would be almost an endless task. Many will be apparent but to suggest a few the wavemeter is useful in measuring the high and low frequency ranges of a coil-condenser combination; it is useful in determining the wavelength setting of a short-wave or other transmitter; it may be used, in conjunction with a receiver, to determine the transmitting frequency of a received station; it is used to calibrate the frequency range of receivers and transmitters; it may be used to adjust receivers to the frequency of a station whose position on the tuning dial is not known previously.

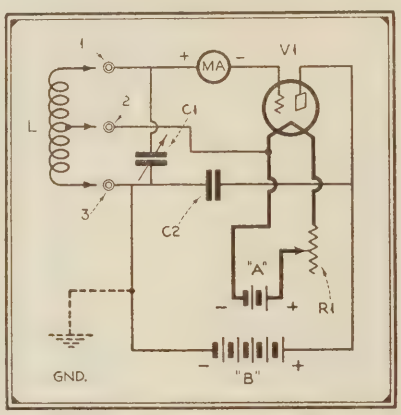
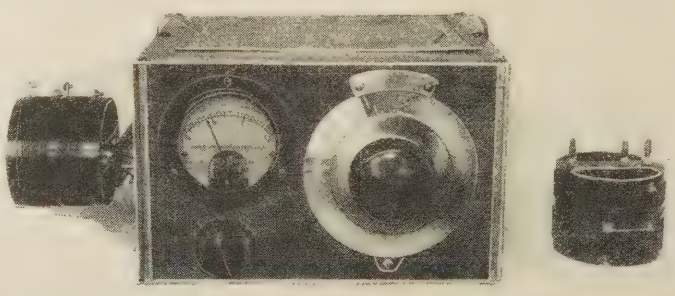


Fig. 1. The circuit of the grid-dip meter. A single –99 tube with its associated batteries, together with a plug-in coil, tuning condenser and milliammeter, are all that are required

There are many types of wavemeter ranging from the simplest one consisting merely of a coil and condenser arrangement which is calibrated in wavelength or in kilocycles to the finely made and highly accurate radio-frequency oscillators. The wavemeter which is described here may be classed as one in between these two extremes. It consists of a simple form of oscillator with a meter inserted in the grid circuit of the oscillator tube to give a reading indicating resonance with the circuit under measurement.

How It Works

Its principle of operation is simple. If you set up an oscillator with a milliammeter inserted in the grid circuit of the oscillator tube, then, when plate and filament batteries have been connected, the circuit will oscillate, as indicated by a reading of current in the grid milliammeter. Depending upon the setting of the condenser which tunes the coil of the oscillator to some frequency within its band a wave will be set up corresponding in frequency to the setting of this coil-condenser combination. Now if a second tuned circuit be brought within the influence of the electromagnetic field set up around the oscillator coil no interaction will be apparent. But, just as soon as the second circuit is tuned to the frequency of the oscillator then things begin to happen. Much of the r.f. current generated by the oscillator is absorbed by the circuit under measurement, causing the initial reading of the grid meter to decrease greatly. The closer the second circuit is to the oscillator coil the greater will be the absorption and consequently the greater will be the decrease in the meter reading. As the dial of the second circuit's tuning condenser is rotated over a small arc it will be noted that the needle of the meter takes a decided dip, from whence the wavemeter obtains its name, a grid-dip meter. As the circuit under measurement is moved away from the oscillator the dip becomes less noticeable and it is under such conditions that greatest accuracy is obtained. The reason for this is that the closer the measured circuit is to the oscillator the greater will be its influence on the latter, even when the former is slightly out of resonance with the oscillator. However, when the coupling be-



The grid-dip meter set up and ready for business. By means of the plug-in coils a wide range of wavelengths may be covered. A chart showing each coil's calibration curve is held down to the top by means of spring clips

a Grid-Dip Meter

Here's a Simply Constructed Piece of Laboratory Apparatus Which Every Experimenter, Especially the Short-Wave Enthusiast, Ought to Have in His Workshop. It's Handy for All Sorts of Measurement Work Involving the Indication of Resonance or the Accurate Identification of Wavelength Adjustment

By John B. Brennan, Jr.

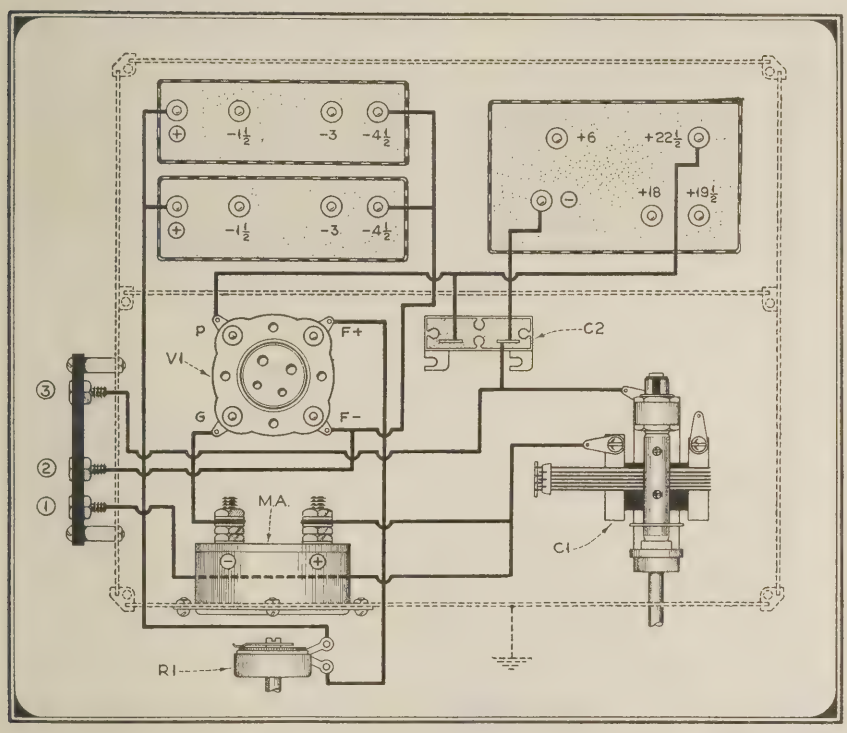
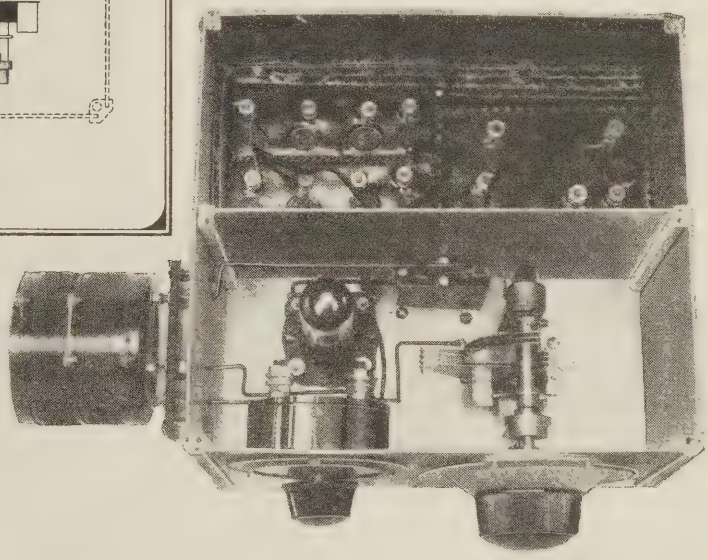


Fig. 2. In this pictorial wiring diagram each of the parts employed in the construction of the meter is shown in the relative position it will occupy in the finished job



Compare this photograph with the pictorial wiring diagram shown above, to the left, for greater clarity in identification of the parts

tween the two has been reduced the absorption effect of the tuned circuit upon the oscillator is manifest only when the two circuits are actually in resonance, the needle of the meter giving ever so slight a dip as the tuning dial of the measured circuit is moved only slightly. The same thing holds true if the dial of the tuned circuit is adjusted to some fixed but unknown frequency. Then, as the dial of the oscillator condenser is rotated a grid dip will be noticed when the oscillator is exactly in resonance with the tuned circuit. Providing the oscillator has been calibrated so that the condenser dial reading may be translated in terms of wavelength or frequency, it is merely necessary to look up the frequency adjustment of the oscillator at its condenser setting to obtain the frequency adjustment of the circuit under measurement.

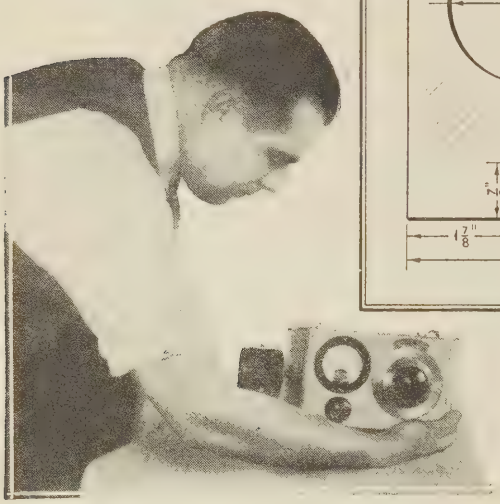
Essentially the circuit, as shown in Fig. 1 consists of a coil shunted by a variable tuning condenser, these two connected to the elements of a –99 vacuum tube. The coil is tapped so that a part of it is connected in the grid circuit of the tube while the other part is inserted in the plate circuit. Thus, we have a simple Hartley oscillator circuit.

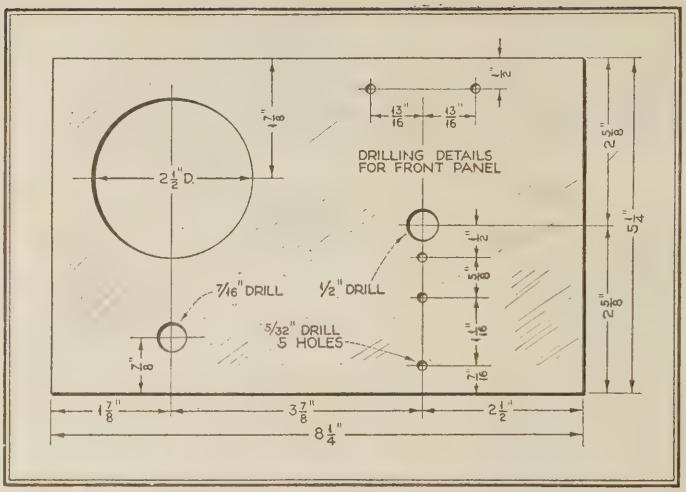
To employ the grid-dip oscillator circuit as a laboratory instrument for the various measurement work it is called upon to perform it is necessary, of course, that the oscillator be calibrated in wavelength or frequency against a standard whose accuracy cannot be doubted. Not always does the experimenter have such a standard at his disposal but there are other means by which he can accurately calibrate his wavemeter. One of the simplest is by setting up a simple three-circuit regenerative receiver, a one tube affair, and tuning it to some broadcast station whose frequency adjustment is known to be accurate and constant. Then, by clicking the oscillator against the second, third, fourth, fifth and so on harmonic of a received station a number of calibration points may be obtained by which a calibration curve may later be prepared. By tuning in on several such stations many points may be obtained, thus adding to the accuracy of the calibration. The actual calibration of the oscillator will be taken up in a later paragraph, in greater detail.

Construction Details

The several photographs and line drawings accompanying will illustrate the simplicity of construction of the grid-dip meter. All of the apparatus, including both the filament and plate batteries are contained in the same shielded box as the meter apparatus, being separated from the latter by means of a compartment wall. In the front section of the box is lo-

Fig. 3. Below, the relative size of the meter is indicated, while to the right is shown the panel drilling details for the face of the metal box





cated the tuning condenser, tube socket, amperite for filament control, and the bypass condenser. On the front panel is located the grid milliammeter and the condenser with its dial. On the left wall (looking at the front of the box) is located the bakelite coil receptacle with its pin jacks. By means of a couple of spring brass clips attached to the side of the box and fitting snugly over the top the calibration charts are at all times kept with the meter.

Wiring of the grid-dip meter is shown in detail in the two figures, Fig. 1 and Fig. 2, the first showing a schematic circuit and the second a full picture wiring diagram. In the latter all the parts are shown in the relative position they will occupy in the completed instrument. Details for drilling the various sections of the shield can are shown in Figs. 3 and 5.

In order to make the grid-dip meter as universal in application as possible it is necessary to wind several coil units so as to cover a multiplicity of wavelengths. The coil chart shown in Fig. 4 gives an idea of the number of coils required together with the number of turns of wire to be wound on each one. Extreme care should be taken in the winding of these coils and once it has been determined by calibration that the coils will cover the desired wavebands without leaving gaps but rather by slightly overlapping, some sort of binder should be applied to them to keep the windings in a fixed position. Rubber cement, ambroid cement, celluloid dissolved in acetone to make a cement, or even small dabs of shellac will serve admirably for this purpose.

Calibration

If you have access to an accurately calibrated wavemeter or oscillator the job of calibrating your own meter against it resolves itself merely into the work of setting the standard at some known frequency and then coupling your own meter to it, revolving the dial until an indication of resonance manifests itself on the indicating meter of one or the other or both instruments. For instance if you want to calibrate the 80-meter coil of your meter look up the chart of the standard, see which coil of the standard covers this wavelength at its top end, that is around 100 on its dial, and then insert it in the standard's circuit. Turn the standard on, if it happens to be an oscillator, and then, loosely coupling the meter under calibration to the standard's coil, rotate its condenser, meanwhile leaving the standard's condenser setting fixed, until the grid meter in the test oscillator gives an indication of resonance. If the indication is too strong, manifesting itself over several degrees of the condenser dial then loosen the coupling between the standard and the test oscillator until only a slight indication of resonance is given on the meter. On a pad make note of the position of the test condenser dial and then reset the standard to 90. Repeat the tuning to resonance at the new setting noting on the pad the new position of the test oscillator's dial. This procedure should be repeated at 80, 70, 60 and so on down the dial of the standard to zero so that the whole waveband of that particular coil is covered. Another way of calibrating the coil is to set the test oscillator dial at 100 (test oscillator referring to the oscillator under test and to be calibrated) and then tuning the standard to resonance with it.

Where a standard is not available then recourse must necessarily be made to those sources of standard frequency which are at the disposal of practically everyone who listens in on a radio receiver. It is a well-known fact that there is present

(*Continued on page 75*)

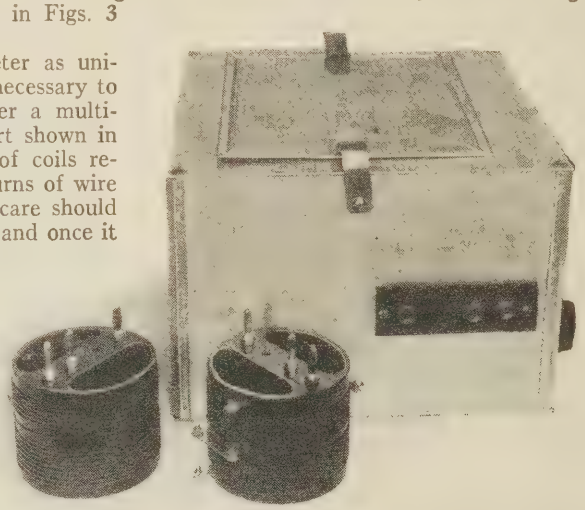
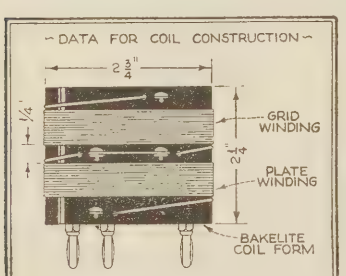


Fig. 5. The side of the box supporting the coil mount is drilled in accordance with the layout given below. Also details for constructing the coil mount are shown

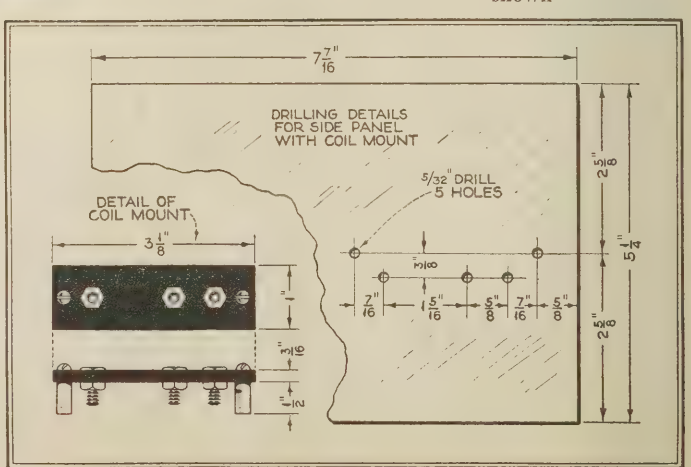


COIL NO.	WAVELENGTH RANGE IN METERS	TURNS, GRID WIND.	TURNS, PLATE WIND.
1	78.30 TO 138.46	8	8
2	84.27 TO 49.18	5	5
3	52.17 TO 35.08	3	3
4	36.58 TO 25.99	1¾	1¾
5	26.11 TO 17.34	1	1

ALL COILS WOUND WITH NO. 16 D.S.C. WIRE

The coils for various wavelength ranges plug in to a coil mount supported on the left end of the metal box

Fig. 4. Five coils, wound as shown, to the left, will cover wavelengths ranging from 17.34 to 138.46 meters. Other coils, of course, may be wound and calibrated to extend this range



Some Types of HUM and how to Locate, Measure and Eliminate Them

By Benjamin F. Miessner

Usually We Are Prone to Class Practically All of the Disagreeable Noises Emanating from a Faulty Receiver Under the General Heading of Hum, and to Assume That They Come Directly from the A.C. Line. Speaker Hum, Grid Bias Ripple, Audio Input Induction and Modulation Hums Are Only a Few Which Confront the Serviceman

WHILE it is possible in a few minutes' time to locate fairly definitely the more usual hum sources in a receiver by the methods which have been outlined in this series of articles, nevertheless a complete, quantitative hum analysis will in any case be a valuable design aid, and sometimes a very necessary one. I have prepared a series of tests involving numerous circuit changes in the receiver which, if carefully carried out, will serve to locate and measure practically all types of hum. Some suitable hum measuring method should of course be available. Tests, for sake of simplicity, are based on the use of an a.c. vacuum tube voltmeter connected across the input to the speaker.

The tests which follow are so arranged that the hum is measured in a backward order from output to input ends of the receiver.

Speaker Hum. If the speaker is of the electro-magnetic or inductor types using permanent magnet field excitation, or electro-magnetic excitation produced by ripple-free direct current, no hum will be developed in it unless it is located in some very powerful a.c. field; I personally have never noted such a case.

Dynamic speakers, however, do almost always develop hum of some degree, due especially to coupling between field and moving coils. To measure this, allow the field coil to receive its normal excitation, disconnect the input transformer primary from the receiver, and connect across it the measuring device and a load resistance equal to the plate impedance of the tube or tubes normally connected across it. Also substitute a dummy load resistance in place of the power tubes in the receiver, if the speaker field is energized from the set rectifier. If a power transformer or the input transformer, or any other a.c. stray field device is mounted on or near the speaker, these may be removed and then replaced separately for further analysis of the speaker hum.

Plate Ripple in Output Tubes. If the speaker has no measurable hum, it may be connected back in the receiver circuit and the hum meter connected directly across its input transformer primary, or across the speaker itself if no transformer be used; if the speaker hums, it is best to connect in place of it, across the tube output, an equivalent resistance.

The filaments of the power tubes are excited by a battery and the grid circuit from grid to filament return point is opened and a "C" battery of correct voltage instead of the normal transformer secondary and grid bias device. Thus only the plate current ripple remains as a hum source, excluding induction sources, which are usually unimportant in this stage This hum then is measured.

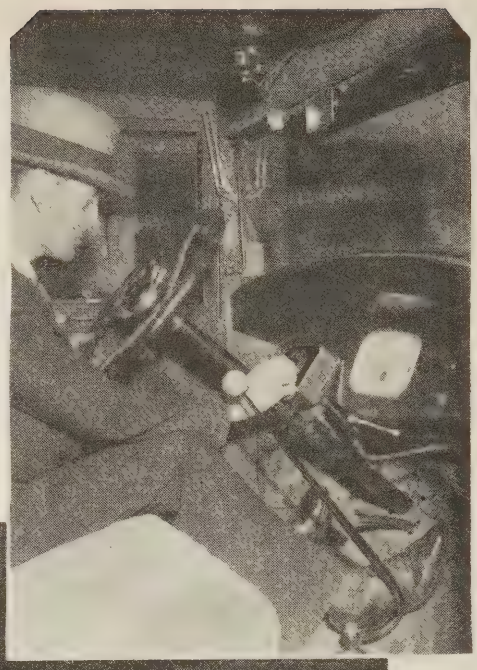
Filament Hum. The filament and mid-point return may then be tested for hum by removing the "A" battery and using the normal a.c. excitation, substituting a "B" battery for the rectified plate current supply and leaving the grid battery in place. The dummy plate load of this tube should of course be used, but so connected that it does not enter the tube circuits.

Grid Bias Ripple. The grid bias in the power stage may now be tested by taking off the grid battery and substituting the normal power supply bias with input transformer shorted, and reconnecting the "A" battery instead of the a.c. filament supply. The "B" battery should be connected between the "B" point of the output circuit and the filament return, and a dummy load connected between the "B" point of the filter for the power stage and the filament return in this stage, so that the normal biasing voltage and ripple will be developed.

Power Tube Input Power Induction. If now with power tube operating entirely on d.c., and the filter provided with a dummy load instead of it, the primary circuit of the power tube input transformer be opened, and shunted by a resistance equal to the plate impedance of the first audio tube, any magnetic induction into this transformer, or any static induction to the second audio tube, may be measured. Ordinarily this is negligible, but may (*Continued on page* 76)

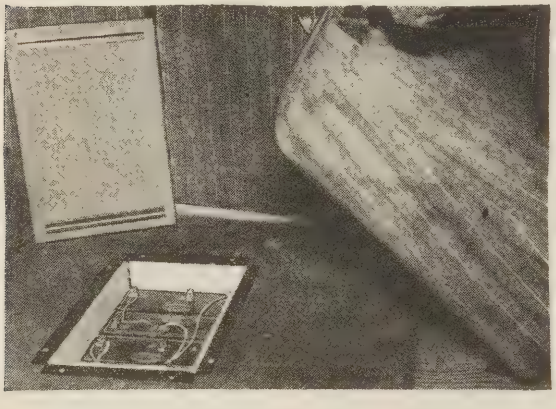
Radio

RADIO-EQUIPPED automobiles are coming into increased daily use. The photographs shown on these pages illustrate only a few of the many makes of auto-radio receivers being manufactured for set users and builders. Automobile manufacturers are equipping their cars with built-in antennas, other manufacturers have set up machines to turn out specially constructed resistors for the elimination of ignition interference, while



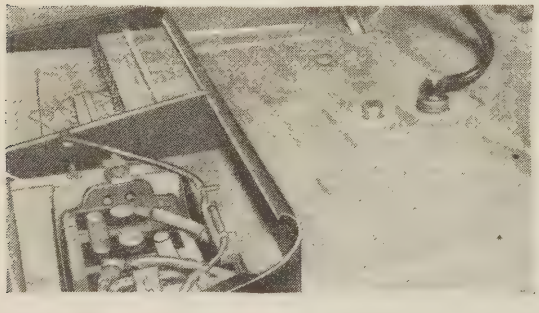
The photograph to the right and the one below illustrate how Samuel Egert's auto-radio installation fits under the dash, with the tuning and volume control box located on the driving shaft. This auto receiver was described fully in the March and April issues of RADIO NEWS. Note the location of the loud speaker forward of the driver and fastened to the roof of the car

(Above)
So compact is the Transitone auto-radio receiver equipment that it fits snugly underneath the dash without being at all visible to the eye. The tuning-volume control dial offers the only suggestion that an auto-radio installation is contained in the car, excepting of course when it is operating. Then wonderment is expressed as to where on earth the set can be located

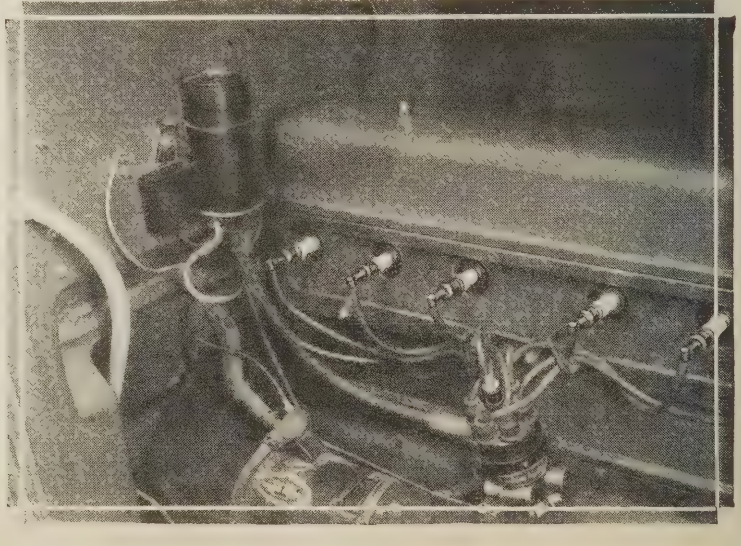


This battery box, containing the "B," "C" and "D" batteries for the Crosley Roamio auto receiver is located just aft the driver's seat in a coach model of car. The cover for the box, which is watertight, is shown in the corner of the picture

(Below)
A Buick, its engine fitted with resistors in each of the spark plug leads and one in the central lead to the distributor. These resistors, together with the by-pass condenser connected to the induction coil, aid in suppressing interference noise generated by the ignition system



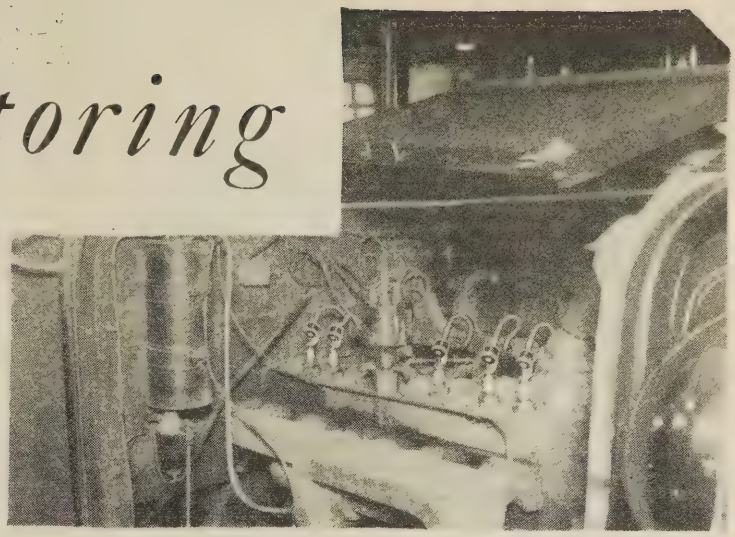
In Egert's Nash ample room for housing the "B" batteries is provided underneath the driver's seat, as shown in the above photograph. The car battery supplies "A" current also to the tubes of the radio receiver



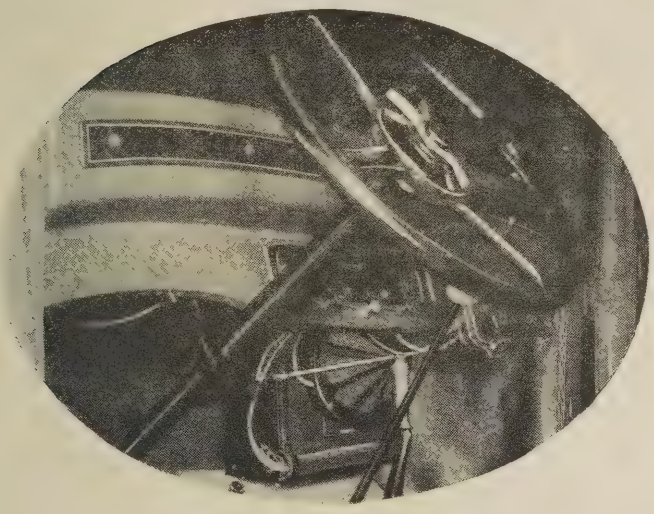
goes a'Motoring

still others are producing loud speakers particularly adapted to automobile use.

Truly, automobile radio is here and here to stay. The photographs on these pages illustrate several of the prominent makes of automobile radio receivers and methods employed in the installation of their associated equipment. Also some receivers, batteries, loud speakers and tuning control mechanisms are shown.

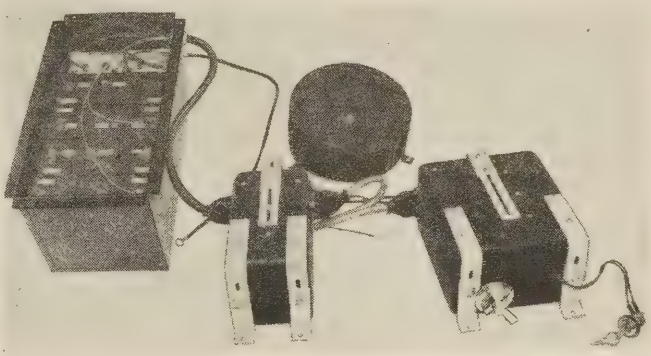


In an automobile each of the spark plugs acts as a miniature spark transmitter sending out a broadly tuned wave which, when the car is installed with a radio receiver, sets up a continuous crackle or roar in the loud speaker. To suppress this type of interference, resistors of about 25,000 to 50,000 ohms are inserted in series with each of the spark plug leads

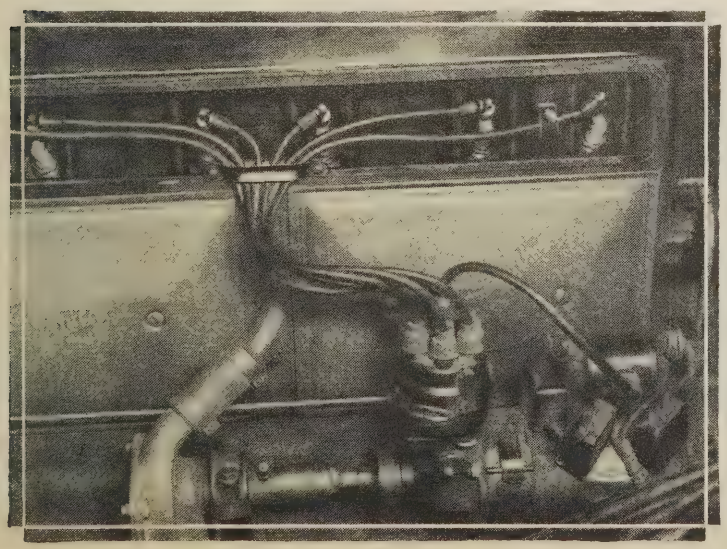


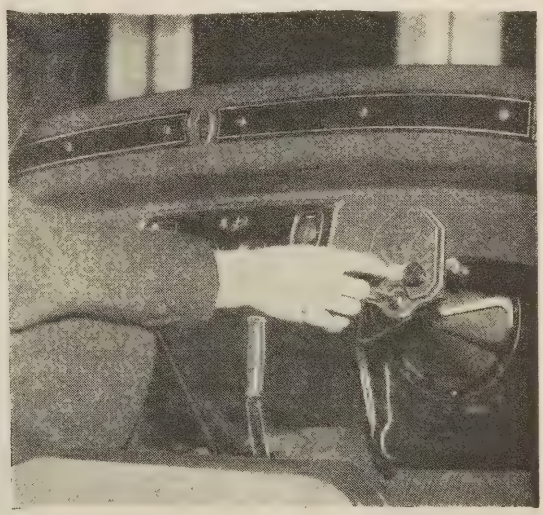
(*Above*)
Here's the other part of the Crosley auto-radio outfit. The control dial fastens on the dash, while the receiver and speaker attach to the bulkhead, separating the engine compartment from the driver's. A straight shaft having two universal joints connects the dial mechanism to the receiver condenser shaft

(*Below*)
Another spark plug resistor-installation. In some cases the entire ignition system has been shielded by the use of flexible copper sheathing which covers each of the high tension wires. Here, too, by-pass condensers have been employed in the generator circuit to cut down interference noise



The several units of the Transitone auto-radio installation are shown above. At the extreme right is shown the filament switch, then the tuner unit, next the speaker (to the rear) and then the audio amplifier unit. At the left is shown the battery box



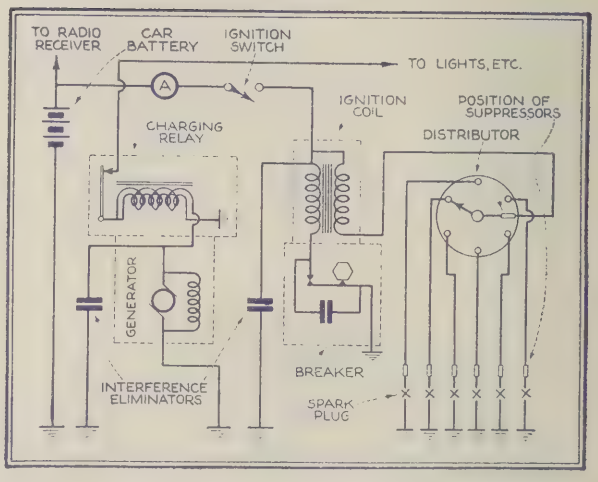


Behind the dash-mounted tuning control panel of the Crosley "Roamio" may be seen the receiver unit with loud speaker fastened to its face. A key switch on the control panel prevents tampering or otherwise inadvertently leaving the set turned on when not desired

How to Get *The* MOST

By A. V. Nichols*

Above, A. A. Leonard, Chief Engineer of the Automobile Radio Corporation, at the dial of a Transitone auto-radio receiver. To the right a circuit of a typical ignition system of a car showing the placement of the interference-eliminating condensers and spark plug suppressors



RADIO has come into motoring as the newest thrill of a thrilling age—not as a passing fad, but permanently. The proof of this lies in the fact that leading motor car manufacturers, such as Chrysler, Dodge, Franklin, Packard, Hopmobile, Studebaker, Jordan, Peerless, Pierce-Arrow and many others, are equipping their cars with antennas and providing cut-outs in the car floors for battery cases so as to make radio installation a quick and inexpensive proceedure.

The idea of radio reception, and also transmission, in motor vehicles is by no means new. Years ago the utility of a mobile receiver or transmitter was recognized but the difficulties to be overcome were so great that a practical installation could not be made. Many cars were equipped however for the purpose of checking the operation of stations, tracing static disturbances, etc.

Infancy of Auto-Radio

Let us go back five or six years and take a look at auto-radio in its infancy. The first sets were invariably operated on separate batteries. Antennas consisted of loops or wires strung either outside or inside the car body, which was far from decorative. Nor was it practical.

The writer vividly remembers one installation in which a loop was mounted on the radiator cap and rotated from the drivers seat by means of strings running through a hole in the windshield. Usually the entire rear section of the car was given over to the receiver and its associated equipment, thereby reducing the capacity of a five- or seven-passenger car to two persons, the driver and the "radio operator."

Interference, caused by the electrical system of the car, was the great stumbling block and until this was successfully overcome little progress was possible.

In 1927 a practical and comparatively simple method of eliminating ignition interference was developed and since then great strides have been made.

Modern Installation

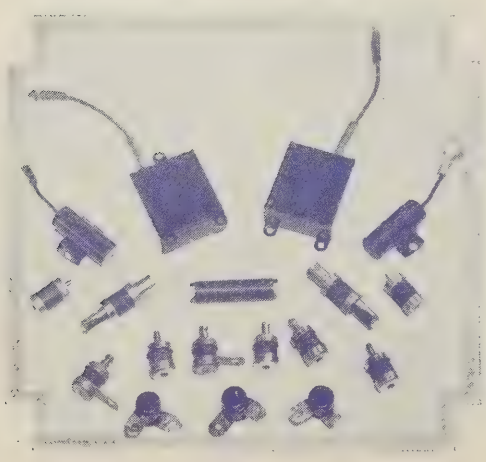
The modern auto-radio is completely concealed and occupies no otherwise useful space within the car. The plate supply batteries are carried in a watertight case beneath the floor, the antenna is built into the top, filament supply is taken from the car battery and the receiver and speaker are mounted out of sight under the cowl. The only visual indication of radio equipment is a single dial and key switch on the instrument panel, designed and finished so as to harmonize with the car instruments and controls.

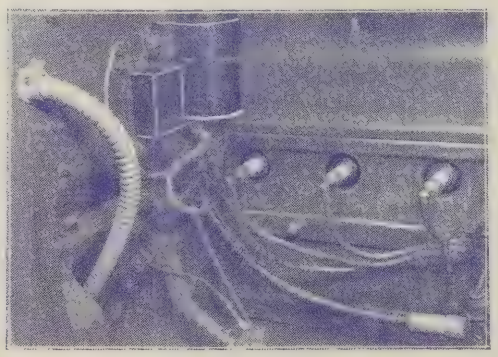
The requirements of an automobile radio receiver are: compactness, as the space available for its location is at a premium; ruggedness, as it will be subject to severe abuse; high sensitivity, as the antenna area and effective height is limited; selectivity and low power consumption, the battery supply, both "A" and "B" being limited. The fulfillment of these requirements calls for some departure from standard practices of receiver design. High amplification and selectivity, together with the necessity of compact design, call for several tuned circuits. Low filament consumption and ruggedness favor the choice of –01A type tubes. In properly designed circuits, embodying careful shielding and efficient filtering, sensitivity of better than 5 micro-volts per meter may be obtained with three –01A and a –01A detector.

The use of a –12A type tube as a detector is advisable as the thermal lag of the oxide filament eliminates the possibility of modulation by any slight generator noise present in the filament supply.

In the mechanical design of the receiver, especially the tuning condensers and tube

*Radio Engineer, Automobile Radio Corp.





Spark plug resistors applied to a Buick. The condenser for the ignition coil is also shown. The photograph to the left illustrates types of interference eliminating spark-plug resistors and condensers

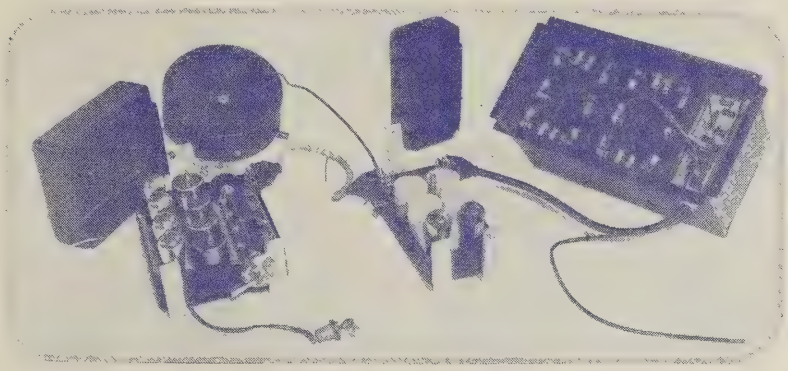
from Your Auto Radio

Radio in Automobiles Is Not a New Idea. The Auto-Radio Receivers of Several Years Ago Were Huge Affairs, Often Requiring the Whole Car or a Large Part of It for the Installation. Today's Auto Receivers Are the Essence of Compactness and Efficiency, Lending Themselves Readily to Concealment in Those Portions of the Car Which Are Not Ordinarily Occupied

sockets, special precautions must be taken to prevent vibration and subsequent modulation of the signal.

Accessibility

Although the set is concealed it must be readily accessible for service and inspection. This requirement is important as the car owner cannot be expected to tolerate leaving his car in the service station if repairs are necessary.



An exposed view of the Transitone auto-radio receiver installations showing the two receiver units with their covers, the battery box and loud speaker

To facilitate installation and service, the receiver illustrated here is constructed in two separate units, each of which is complete within itself. The larger unit contains the r.f. amplifier and detector and carries the tuning controls. The small unit comprises the audio amplifier, output system and voltage regulator. Each unit is assembled on a steel chassis which is independent of the box. The boxes are of drawn steel and each one consists of two identical sections, separating on the center line. The lower half of each box is mounted in an inverted position behind the car instrument board, well up under the cowl. Special brackets are provided for mounting which are adjustable and will fit all makes and models of cars. After the boxes are in place the chassis are inserted and fastened to the box by means of retaining screws. The upper section or cover of each box is held in place by a knurled screw. The battery cable and the connecting cable between the units is fitted at each end with plug and jack connectors which engage with similar connectors on the chassis. These are so arranged that a misconnection is impossible.

This design considerably simplifies the installation of the receiver and makes the removal of a unit for inspection or test more simple than the removal of the car battery.

The loud speaker is fitted with a jack so that an extension speaker may be plugged in and entertainment furnished at points a considerable distance from the car.

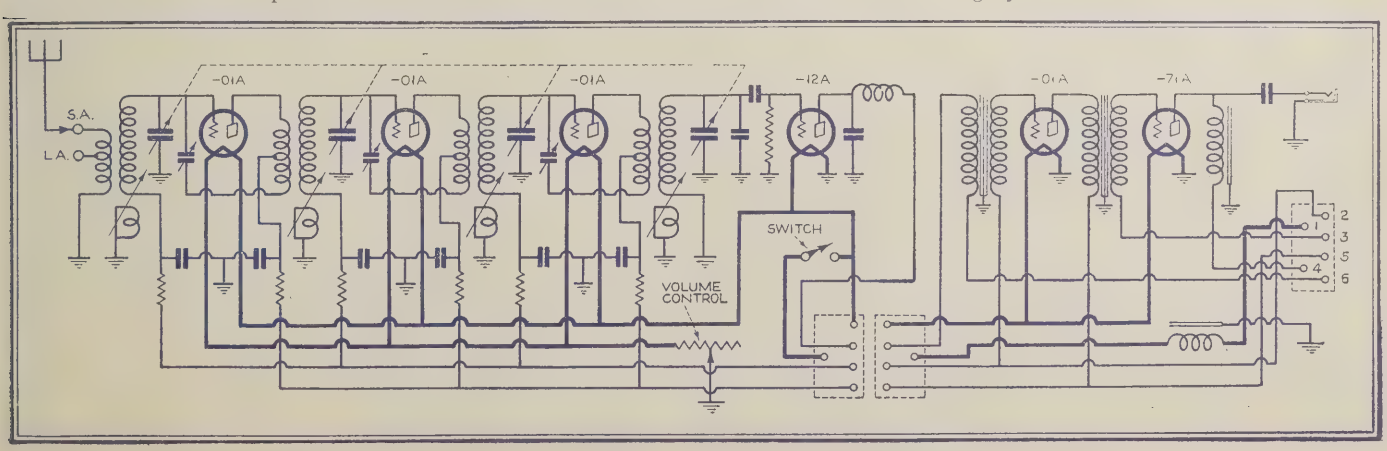
The current drain of the set on the car battery is under 1½ amperes, less than that consumed by parking lights. The "B" battery current drain is slightly under 25 milliamperes and with average use a battery life of from 4 to 6 months may be expected.

Eliminating Interference

The method of eliminating interference set up by the electrical systems of the car is shown in Fig. 2. In the great majority of cars the distributor head or high tension commutators is of the spark-gap type. In all such instances an interference suppressor in the center lead will be necessary. In some cars, however, the high tension commutator is of the wiping contact type and in these cases the suppressor may be dispensed with.

The suppressors consist of specially processed carbon resistors with a value of approximately 25,000 ohms. The common type of resistor, such as is generally used in radio sets is not suited to this work, as the resistance value tends to change when subjected for long periods of time to high-potential discharges. In addition to this the resistance value must remain effective at ultra-high frequencies, as the oscillatory current to be suppressed is usually of a frequency lying between 10 and 60 megacycles.

Below is shown the fundamental circuit employed in the Transitone auto-radio receiver



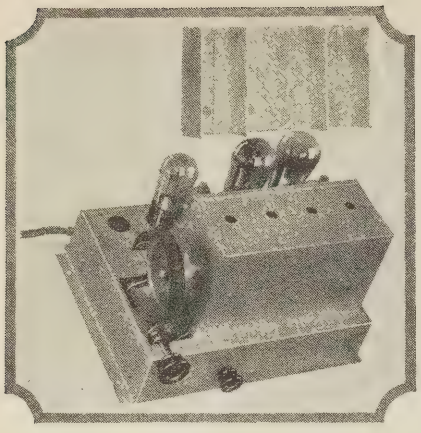


Fig. 1. This is a photograph of the tuner whose circuit is shown in Fig. 8. It employs only one band-pass circuit

Today's Broadcast

Being the discussion of unique de of receivers to be presented to Dual selector circuits, power detec hum-free power unit design are

By McMurdo

AT the June Trade Show there will be announced two new chasses for the 1930-31 season which it is felt will embody some of the outstanding engineering developments of the season. These two receivers incorporate such unique design features that it is felt a description of these features will be of interest to readers of RADIO NEWS. Photographs of laboratory models are shown in Figs. 1 and 1A. Both receivers have separate assemblies for tuning and audio units and the power unit, a common power unit being used for both, which is clearly illustrated in the photograph in Fig. 2.

The principal difference in electrical characteristics of the two receivers is a matter of selectivity, for the sensitivity is practically the same in both. This difference in selectivity is accounted for in the fact that an additional tuned circuit is employed in one of the models over the four tuned circuits used in the other. It will probably result in least confusion if the two types of receiver are described separately, starting with the first, which has been designated for discussion as model 32-A.

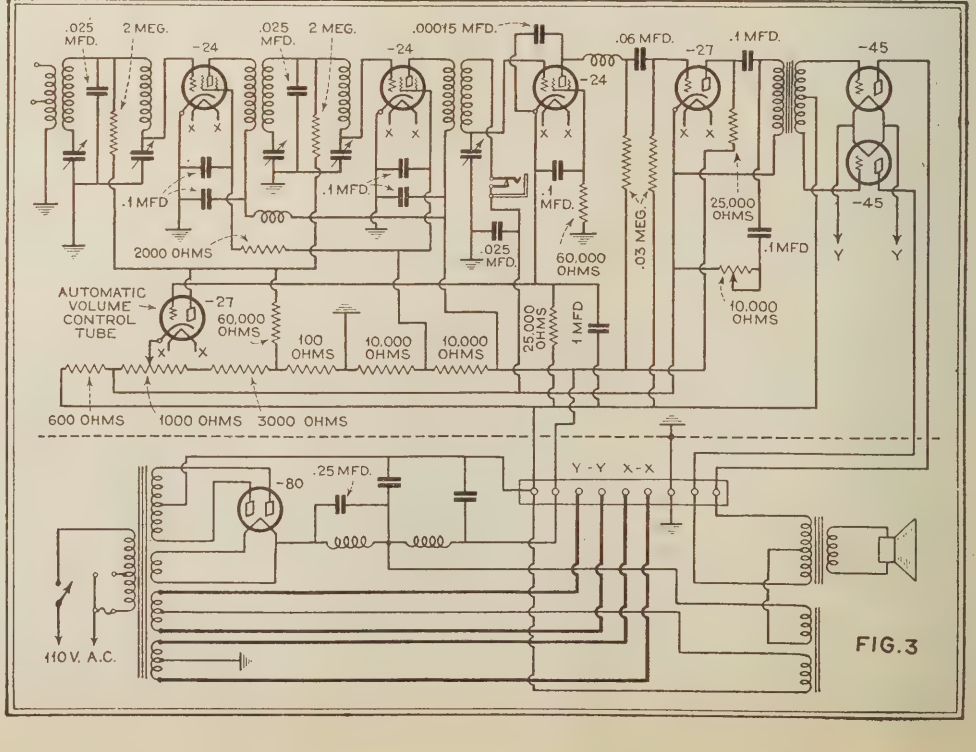
It will be seen in the circuit diagram in Fig. 3 that the layout consists of two selector circuits, one between the antenna and first radio-frequency amplifier and the second interstage, followed by a further single tuned stage. The detector is of the screen-grid type, operating into a –27 first audio tube, thence into a push-pull transformer and terminating in a pair of –45 output tubes.

The merit of using a selector circuit between the antenna and first tube has been too well discussed in the past to necessitate a lengthy dissertation at the present time. It is well known that with commercial coils the resonance of a single tuned circuit is not sufficiently narrow to completely eliminate crosstalk or modulation effects in the first r.f. tube when operating a receiver very close to a powerful broadcasting station. By the use of two tuned circuits loosely coupled, sufficient selectivity is obtained to give 100% assurance of freedom from crosstalk. This point has been thoroughly checked in the laboratory by the use of intense field strengths from a signal generator and, from a practical point of view, by the operation of the receiver within a half mile of a 50,000-watt transmitter with absolute freedom from crosstalk. The second selector circuit employed interstage is of essentially the same design as the first, except that it is arranged for coupling out of a –24 tube with a 1:1 turns ratio and practical unity coupling coefficient.

The first selector is, of course, arranged with a smaller primary having two taps, the first producing a negligible upset in tuning when used with antenna capacities up to 100 micro-microfarads and the second permitting the use of antennas up to 500 micro-microfarads. In both selectors the coupling is somewhat below what is ordinarily termed "sufficient," so as to produce the characteristic single-peaked resonance curve rather than the double-humped curve which has been so much discussed and whose only merit seems to be the improved transmission of the higher modulation frequencies. Considerable selectivity is sacrificed, however, by coupling above critical coupling, and it seemed desirable to realize the utmost in selectivity from these two selectors and to keep high modulation frequency suppression at a minimum by the use of a properly designed audio channel. In addition, our studies have shown that selector circuits coupled below critical coupling do not unduly suppress the 5,000-cycle side-band which is desirable for high quality reproduction, as will be evident from the selectivity curves to be presented.

Special care has been exercised to maintain the grids of both the radio-frequency and detector tubes sufficiently negative so that no current is drawn at high signal level, a great aid in keeping the selectivity at a maximum. The overall selectivity of this tuner is shown in Fig. 4. It was taken by standard methods and indicates band widths at ten, one hundred,

*President, Silver-Marshall, Inc.



The circuit of the model 32-A receiver, employing two stages of band-pass circuit. The power supply shown in the lower section of the diagram is the same as that used with the model 31-A

Receiver Trend

sign features embodied in two types radio users the coming season. tion, automatic volume control and several of the high spots described

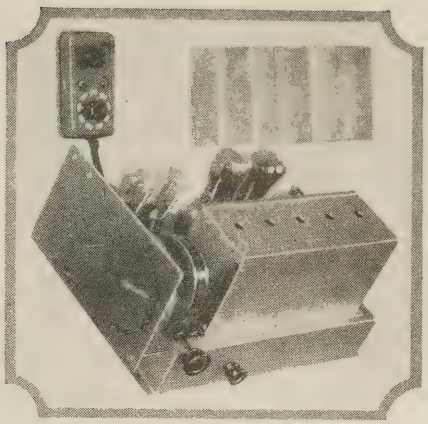


Fig. 1A. To the right, the two band-pass circuit tuner, showing the application of remote control

Silver*

and one thousand times normal field strength, equal to superheterodyne performance. It will also be observed from these curves that selectivity at one hundred times and one thousand times down is somewhat extraordinary; the response at 5 kc. off resonance, corresponding to the higher modulation frequencies, is down only two and one-half times. This decrease in intensity of the high modulation frequencies has been largely compensated for by the use of an increased response in the treble of the loud speaker.

The sensitivity of 32-A is shown in Fig. 5 and may be seen to vary from 25 to 100 microvolts, absolute. This means that with an antenna having an effective height of four meters, these figures are to be divided by four.

The audio channel has been very markedly improved over what was considered an acceptable standard in the general receiver market in the past season. This has been accomplished largely through the use of screen-grid detector operating through a resistance-capacity coupler into a –27 tube, coupling the –27 tube into push-pull –45's by means of the tuned audio transformer which has been so popular in the parts field. This coupling is unique, inasmuch as it prevents any direct current saturation effect in the core of the audio transformer, thus allowing the steel laminations to be operated on a symmetrical magnetization curve and resulting in a higher value of effective inductance with a given amount of material used in the design. The application of the tuned principle has been made in a slightly different manner than was customary in the past, inasmuch as the present transformer is made with two separate windings rather than an autoformer arrangement such as was previously used. This allows the primary current of audio-frequency to be returned directly from the plate through the transformer and back to the cathode of the same tube, eliminating the large by-pass or filter which would otherwise be necessary in order not to introduce any out-of-phase voltage in the grid circuit of the –27, which would decrease the amplification at bass frequencies and impair the frequency characteristic to a great extent. Due to the resonance effect between the transformer primary and the condenser in series, the response is somewhat accentuated at bass frequencies. This results in a response curve for the audio system as taken from the phonograph jack to voice coil of the speaker, as shown in Fig. 6, where it will be noticed that the response is up about three decibels from normal level at 50 cycles. This is slightly lower than the resonance point of the dynamic speaker used, which is very effective in reproducing the bass frequencies which are available from some of the more modern transmitters.

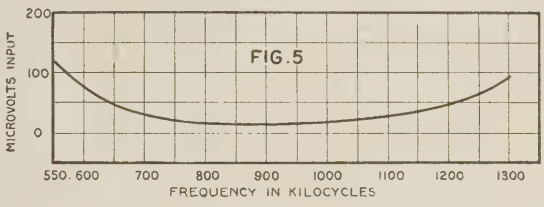


Fig. 5. This curve shows the sensitivity of the receiver illustrated above to vary from about 25 to 100 microvolts

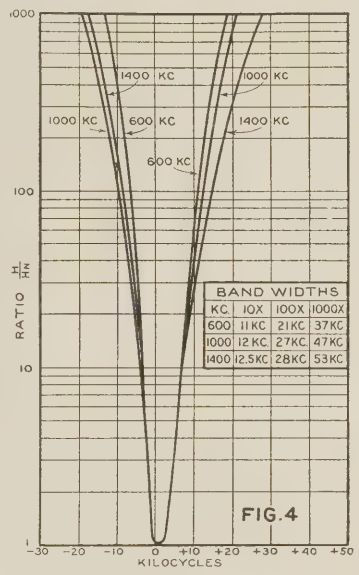


Fig. 4. Curves illustrating the over-all selectivity of the model 32-A tuner. Measurements were made at 10, 100 and 1000 times normal field strength

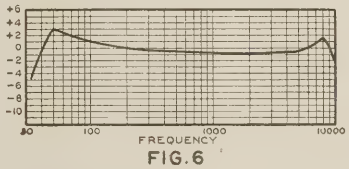


FIG.6

Fig. 6. The response curve for the audio amplifier used with the tuners described here, as taken from the phonograph jack to the voice coil of the speaker

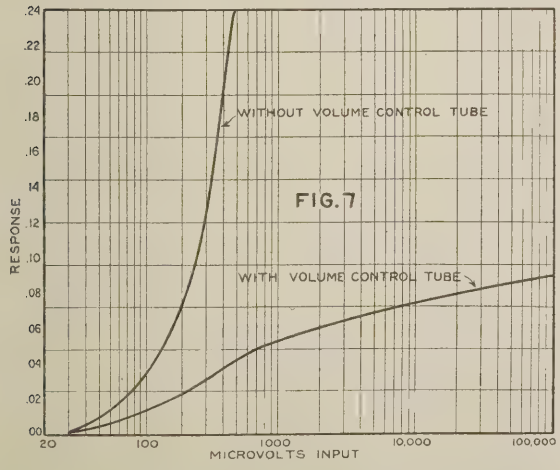


Fig. 7. Two curves which illustrate the performance of the receiver with and without the volume control

A previous receiver embodied in the audio channel a switch on the front panel which permitted two adjustments of treble response in the audio system. In open position, this switch permitted the reception of the high modulation frequencies at practically unattenuated intensity, while in the other position the switch introduced the necessary capacity to lower the audio cut-off point markedly with a reduction in the extraneous noises, heterodyning, etc., which was desirable under many conditions. In addition, it permitted some latitude of adjustment of tonal quality of the receiver to suit the preference of the individual listener. In view of the great popularity of this adjustment, the system has been extended this season to a continuously variable tone control knob on the front panel in order that high-frequency response may be adjusted by extremely small increments from full treble reception to a full, deep response with overtones and high frequencies almost completely missing. This adjustment is accomplished by means of a condenser and variable resistor in series, shunted across the audio transformer. The shaft and knob on the

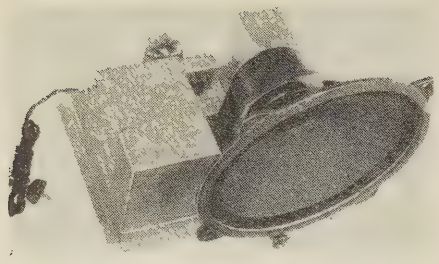
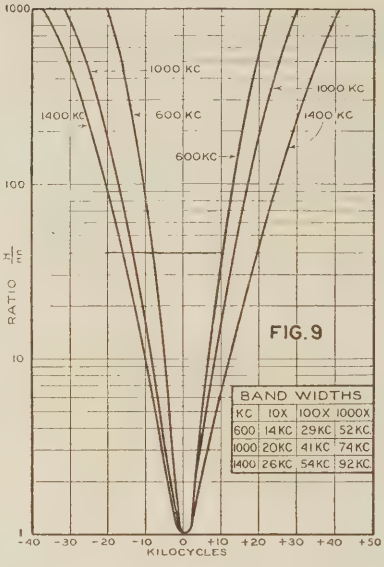


Fig. 2. The power pack and speaker, which may be used with either of the tuners described. Below, selectivity curves for the 31-A receiver show a somewhat decreased selectivity as compared with the 32-A



variable resistor are extended to the front of the panel so that adjustment may be made immediately by the listener and altered in the same manner that tuning is accomplished. This will, in all probability, be a general trend in receiver design this season.

The application of an automatic volume control to a receiver of this character presented several such unique problems that it was necessary to evolve a new system in order to accomplish the purpose. In view of the extreme sensitivity of the –24 detector, the signal excursions on the grid are necessarily quite small for moderate signals, too small, in fact, to permit of the more conventional type of volume control circuit employing separate rectifier in parallel to the detector to be operated by the same signal applied to the detector grid. Inasmuch as the screen-grid detector is arranged for automatic bias, formed by the plate current flowing through a resistor in the cathode circuit, it was found to be reasonable to use the variation in this bias to operate the grid of a d.c. amplifier tube and to use the output of this d.c. amplifier to control the grid bias on the radio-frequency amplifiers. The operation of this type of control is almost obvious from an inspection of the circuit diagram, where it will be understood that when a loud signal is impressed on the grid circuit of the detector, the d.c. component of the plate current rises, causing an increase in voltage across the resistor in the cathode circuit of the detector. Inasmuch as the grid of the volume control tube is already biased more negatively than the initial drop across this resistor by means of a potential taken from the bleeder circuit, this increase in potential in the detector cathode circuit raises the effective volume control grid bias in a positive direction with an increase in plate current. This plate current in the volume control tube flows through a 60,000-ohm resistor to a point on the voltage divider across which is an added grid bias on the radio-frequency amplifier tubes. The net result is that this increased bias decreases the mutual conductance and, hence, the gain of the radio-frequency amplifier, and reduces the signal impressed on the grid of the detector to a point where equilibrium is reached.

Manual control of the signal intensity has been very nicely accomplished by making the fixed bias on the volume control tube variable, thus permitting the operator to adjust the volume control tube to cut off at any predetermined signal intensity.

Fig. 7 is indicative of the operation of this control, showing as it does the increase in receiver response with various strengths of signals with and without the volume control tube in the circuit. This curve was taken with the receiver set for maximum sensitivity and it will be noted that without the volume control tube the response rises very rapidly to above the overload point of the audio amplifier with about 300 microvolts applied to the antenna circuit, while with the volume control tube in circuit the output is nicely limited even with signals as strong as 100,000 microvolts or .1 volt.

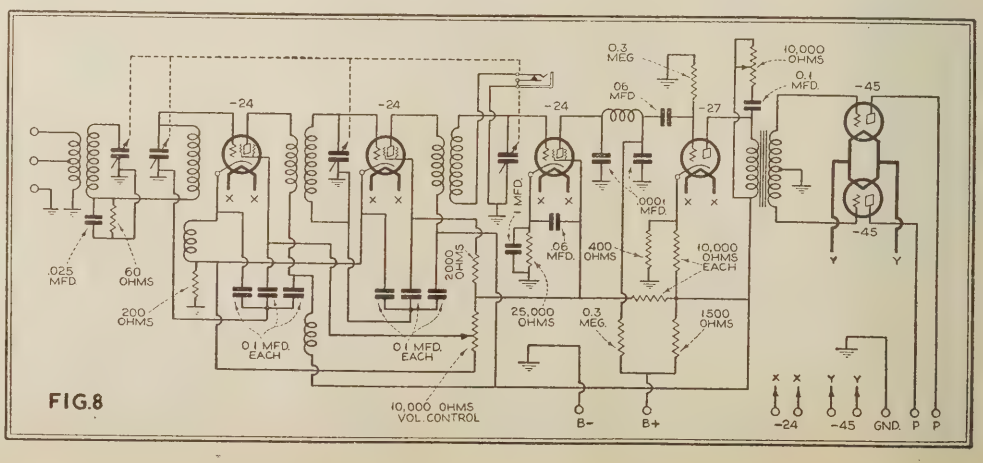
A volume control of this type has one particularly unique advantage from a design standpoint, inasmuch as it is a d.c. operated device and it is unnecessary to make any degree of compromise between the speed of operation of the automatic control and the possibility of reducing low-frequency response through too rapid operation.

In view of the very excellent response of the audio system at low frequencies, a large amount of research and design effort has been expended on the power supply, in order to reduce the hum due to the supply current to an absolute minimum. The use of a separate power pack reduces direct induction effects to a minimum while an especially designed filter keeps the ripple in the d.c. supply current to such a low value that the resultant hum is inaudible six inches from the face of the dynamic speaker. The –80 rectifier tube has been relieved of much of the strain it has endured in the past by the elimination of the usual input condenser to the filter and operating directly into a choke which is tuned to suppress the second harmonic of the line frequency which is 120 cycles in the case of a 60-cycle receiver. This first tuned section with its shunt condenser reduces the ripple sufficiently so that the dynamic speaker field and push-pull output stage can be operated with complete quiet from this point. It will be noted that the speaker winding is divided, the drop across one portion of it forming the "C" bias for the power tubes, while the other is in series with the plate supply to the power tubes. The inductance of the speaker field and the plate supply produces a very desirable effect, inasmuch as its counter E.M.F. opposes at all times any modulation effects in the plate circuit of the push-pull amplifier and permits the tubes to be somewhat overloaded without unpleasing effects, where outputs in excess of the normal –45 are required.

The remainder of the r.f. detector and audio circuits are supplied through an additional choke and shunt condenser which further reduces the ripple to a point permitting quiet operation with the high detector and audio gain provided in the receiver.

Every provision possible has been made in the mechanical design of the power speaker supply to reduce the fire hazard to an absolute minimum, as indicated by past practices of the Underwriters and similar commissions. In order to provide for variations in line voltage obtained in different communities, two separate positions of the fuse are available, connected to taps on the power transformer for nominal 110 and 125-volt operation.

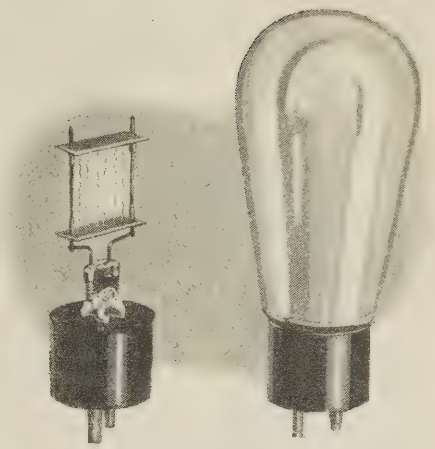
The design of the 31-A model is along such parallel lines as to require practically no description. Fig. 8 shows the wiring diagram, in which it will be noted (*Continued on page* 89)



The circuit for the model 31-A tuner shows that one less stage of band-pass circuit is employed as in comparison to the two stages incorporated in the model 32-A tuner. Otherwise the circuits are practically identical

Compensating A.C. Line Fluctuations with

Line-Voltage Regulators



A typical bulb-enclosed line voltage regulator, showing its "innards," to the left

Don't Always Blame Poor Reception or Bad Tone Quality on Tubes or Receiver. The House A.C. Line May and Usually Does Contribute Its Share of Trouble, Especially During Periods of Heavy and Light Loads. Line-voltage Regulators Reduce Trouble From This Source to a Minimum, if Not Entirely Eliminating It.

By John B. Brennan, Jr.

HAVE you ever given thought to the fact that of all the electrically operated appliances used in the home, the radio receiver operated off the house lighting lines is by far the most delicate and intricate piece of apparatus? Yet in spite of the long daily use to which it is subjected, little or no care is spent upon it. We expect it to perform satisfactorily as a matter of course and class it roughly as just another electrically operated device which can be plugged into a wall socket conveniently. Electric irons, washers, heaters, motors of all sorts are rugged things compared to a radio receiver. They can function with perfect satisfaction over wide ranges and conditions of house voltage applied to them. As a matter of fact the only cause for complaint with such pieces of apparatus is when something actually goes wrong, to cause them to burn out or otherwise cease operating.

Not so with a radio receiver. Whether purchased complete or built at home we expect it to live up to the claims made for its performance almost indefinitely. If the set ceases to function satisfactorily or fails of operation entirely invariably the set itself or its tubes are blamed for the non-performance, and in many cases unjustly. An electric radio receiver is designed to operate best only within a narrow range above or below the voltage for which its transformer primary is designed.

To get at the bottom of the real causes for faulty or non-operation of a radio receiver let us analyze the conditions under which it functions. With a.c. operated receivers it is taken for granted that they will be operated from a 110 or 115-volt source. This figure is universally accepted as the line voltage in the United States. At least, a majority of the a.c. receivers manufactured and the parts produced for home-built a.c. operated receivers accept this figure as a matter of course. Now right here is where we're wrong and our trouble begins.

From a survey made in 1928 by *Electrical World* embracing 14,532,930 customers of electric power it has been found that 2,480 are supplied by line voltage rated at 100 volts, 92,170 at 104 volts, 21,220 at 105 volts, 7,624,660 at 110 volts, 181,470 at 112 volts, 5,160 at 113 volts, 124,120 at 114 volts, 3,723,470 at 115 volts, 55,420 at 118 volts, 1,690,130 at 120 volts, 1,040 at 125 volts, 640 at 127 volts, and 388,500 at 220 volts. Added to these there are 425,520 users of direct current which in this analysis will not be considered. Figure out for yourself the chances for satisfactory operation of a receiver whose line transformer has been designed to work from a 110 volt source. Those receivers working on lines as low in voltage as 100 volts will invariably lack volume and show loss of selectivity while those working on lines supplying 125 volts will have not only an over-abundance of volume but short lived tubes, power condensers and rectifier elements, and will distort reception.

As bad as this revelation is it depicts only part of the conditions which exist for in those cases cited at least the line voltage was admitted to be something other than 110 volts. Now consider the actual conditions where each one of these voltages may fluctuate over a range as high as 30 to 40 volts. Is it any wonder that receiver owners despair of decent operation from their receivers? It is fair to assume, too, that since the time this analysis was prepared by *Electrical World* in 1928 the number of a.c. power users has not diminished but rather has increased considerably.

For argument's sake, however, let us assume that all line voltages are standard, that is, 110 (*Continued on page* 87)

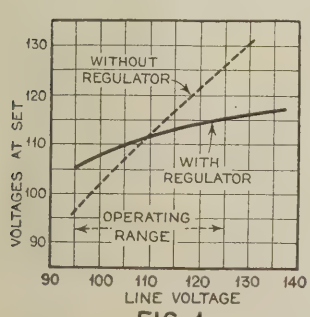


FIG. 1

The excursion of a 110-volt line with and without line voltage regulator

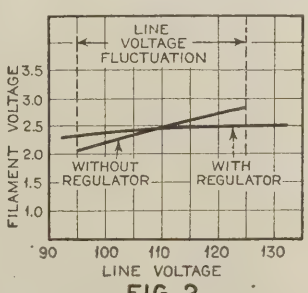


FIG. 2

Note how little variation in filament voltage is experienced when a line-voltage regulator is employed

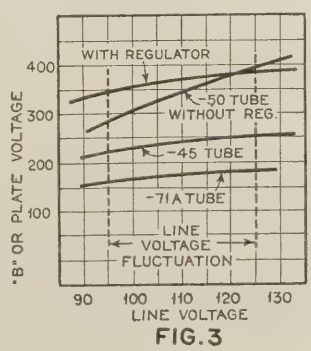


FIG. 3

Curves illustrating variations in applied plate voltage with and without the regulator

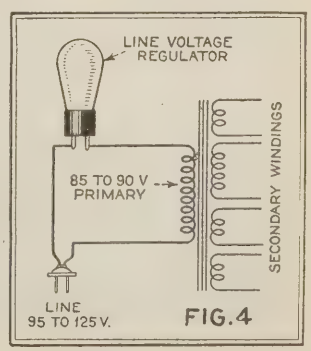
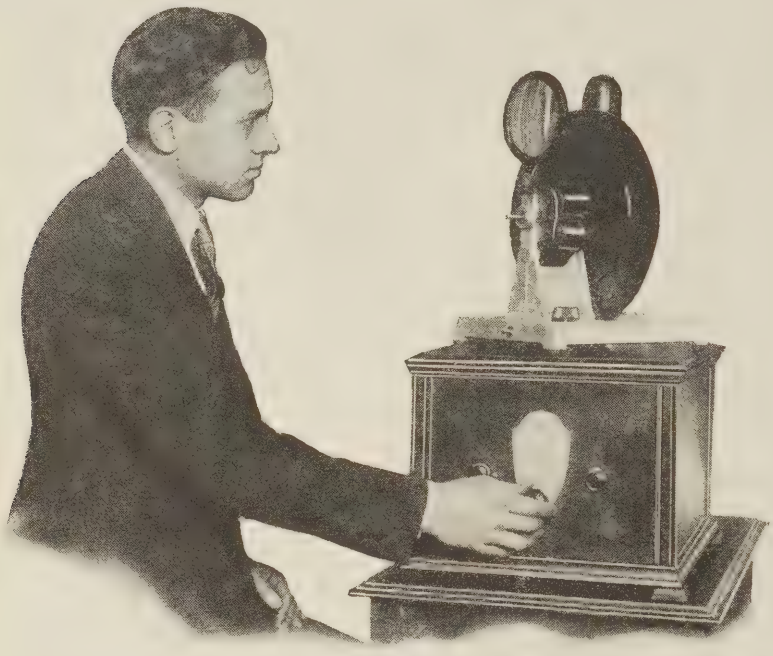


FIG. 4

This circuit shows how the line-voltage regulator is included in the transformer primary circuit

Practical TELEVISION

—Not the Type of Television Which People Were Led to Believe from the Newspaper Ballyhoo of Two Years Ago Was Just Around the Corner, but Practical, Simple, Inexpensive and at the Same Time Interesting, Experimental Direct Reproduction of People and Things Over Fair Distances. The Day When We Will Be Able to See Football and Baseball Games, or the Inauguration of a President Portrayed in

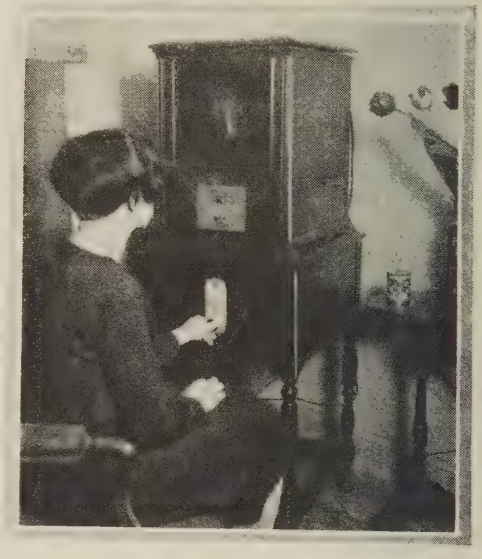


(*Above*)

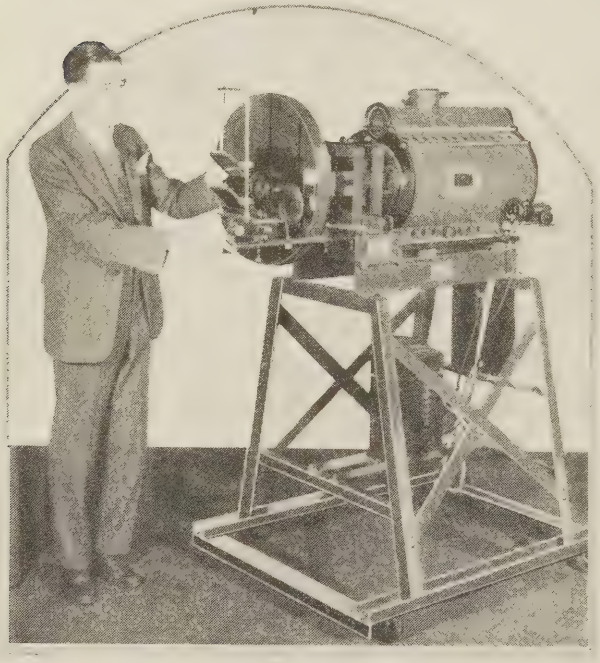
H. G. Miller, of the Jenkins Television Laboratory, is shown operating a new, special short-wave receiver designed particularly for television reception along with one of the simplest, as well as quite satisfactory type, of induction driven scanning disc

(*Right*)

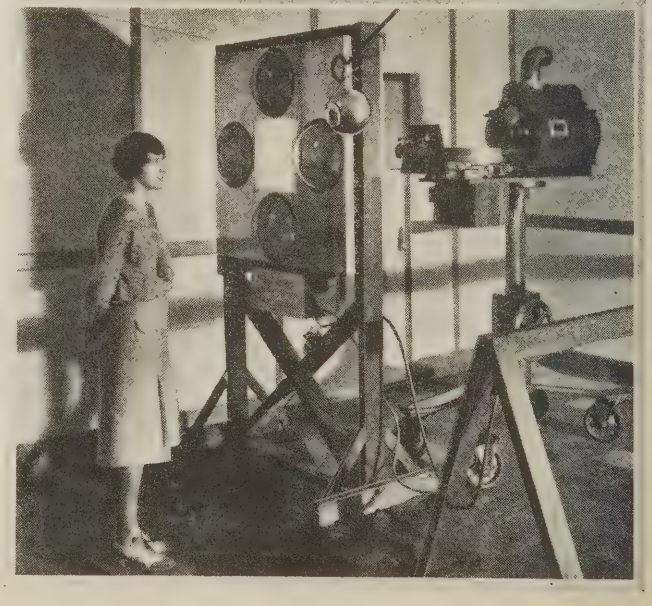
The simple Jenkins television receiver shown at the right has been designed for home use and is completely self-contained. The receiver itself incorporates a band-pass tuning system with a 60 kilocycle width and a resistance coupled amplifier employing screen-grid tubes. The televisor is made with a ball-bearing induction motor and is provided with a special synchronizing device



Station W1XAV, in Boston, transmits on a frequency of 2180 kc. Folks who are being televised broadcast at the same time. An ingenious periscopic scanner is used to align the height of the subjects with the scanning beam



This is a detailed view of the periscopic scanner used by the Baird Television Laboratories. The development of this particular apparatus has taken a long time and has been extremely expensive. Here we have a very definite indication of the real interest now centering on television



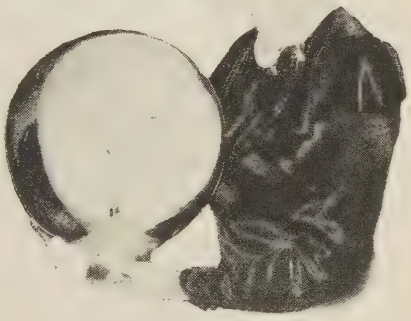
Is Now HERE!

Talking Motion Picture Fashion on Our Living-room Walls by Radio, Is Still Quite a Long Way Off. Independent Groups of Serious Investigators in Various Parts of the Country Have Developed Transmitters Which Operate in a Very Satisfactory Fashion, and Within a Short Time Television Receivers of a Type Illustrated in This Section Are Ready to Find Their Way Into Our Homes.

This illustration shows a Baird televisor equipped with two radio receivers. One for the reception of sound, the other for the reception of the image of the subjects being broadcast

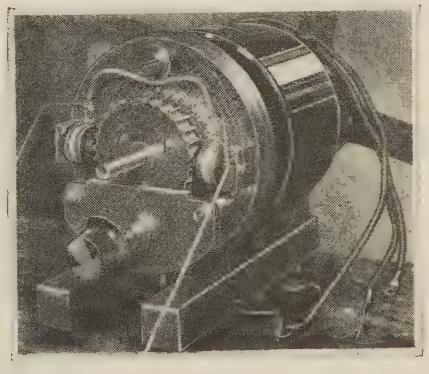
(*Above*)

Miss Marcella Lally, shown above, is seen nightly over the Western Television station, W9XAL, Chicago, which operated in conjunction with sound station WIBO. At the right is the largest photo-electric cell ever constructed for commercial television.



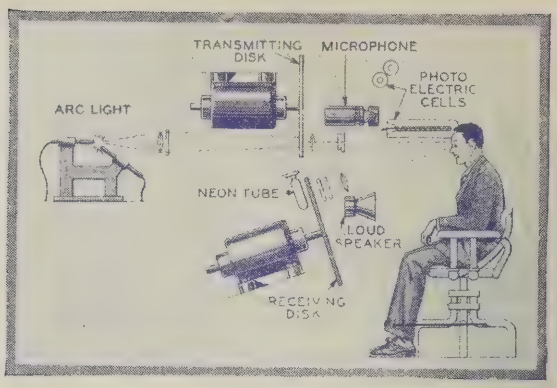
Banks of these powerful cells will permit television actors considerable latitude of movement

This is a general view of the Baird Television Corporation's television studio and transmitting room. A glass window renders the interior of the sound-proof studio visible to an audience during transmission. The attendant at the left is adjusting the Perio-Scopic mechanism to accommodate the artist, Miss June Collyer, in the field of view. Note the photo-electric cells directly above the window facing Miss Collyer

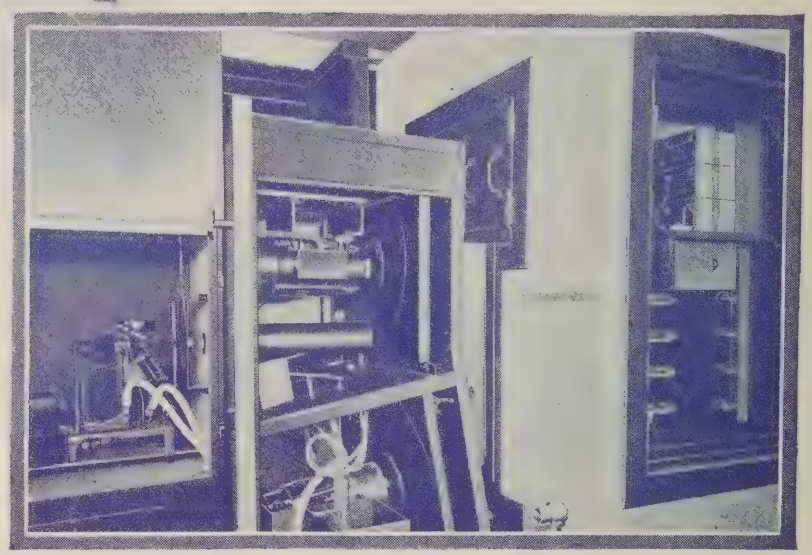


Above is a close-up view of the disc driving motor and Baird synchronizer utilized for maintaining the receiver motor in step with that located at the transmitting station

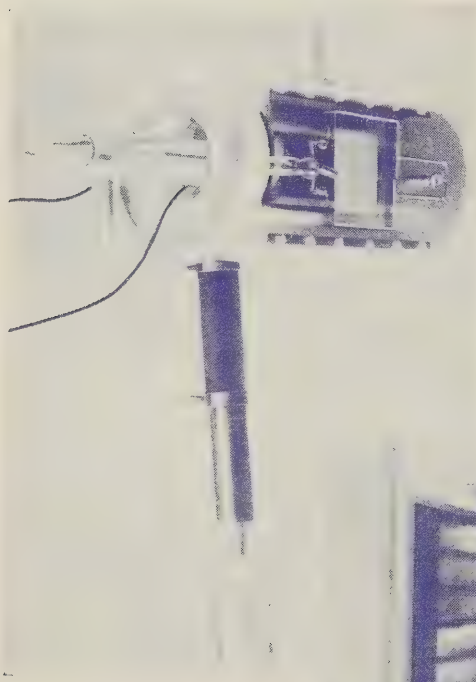
The lady in the picture above is using a home televisor designed by the Western Television Corporation. The large aperture at the top of the cabinet is used for the lens mounting and the picture is seen through this lens. The facsimile of a ship's steering wheel located at the center of the cabinet is merely an artistic touch applied to the synchronizing regulating device



A simple outline of the two-way telephone television system employed is indicated diagrammatically above. The voice is picked up by a sensitive microphone and carried over the line to a similar station located at a distance. The person carrying on the conversation is televised in the usual manner through a group of lenses and a rotating scanning disc



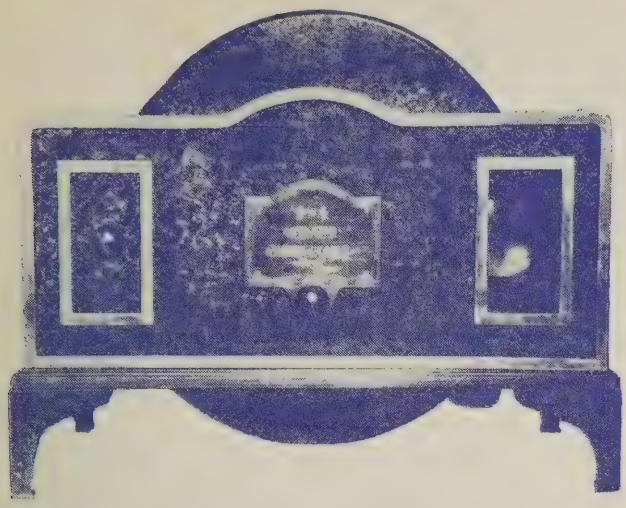
Some idea of the engineering skill and mechanical precision necessary for the accomplishing of two-way telephone television by existing means may be had from this photograph



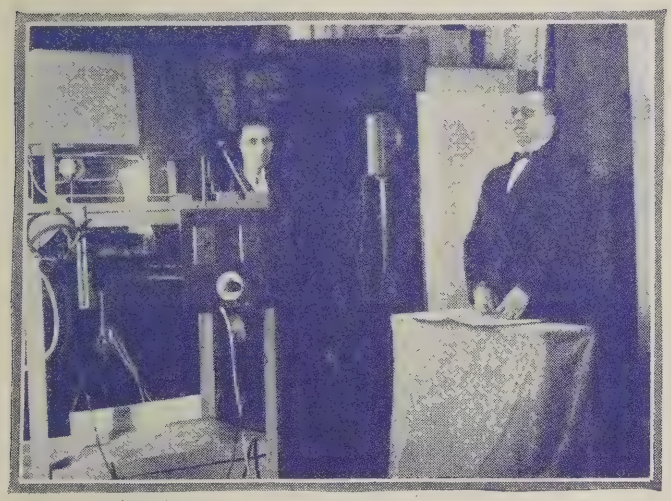
Below we have the inside of the two-way television telephone booth. In using this system you sit in the chair and face the aperture in the center where the facsimile of the person with whom you are conversing appears

This is the water-cooled Neon tube used by the Bell Telephone Company for two-way television. The image of the person being televised appears by the aid of the scanning disc on the small metallic plate shown in the center of the horizontal portion of the tube

An attendant is instructing Miss Esther Ralston in the proper procedure of television broadcasting. The sensitive voice microphone is shown in the background and the photo-cells are directly above the window, which is shown at the right. These cells had to be covered while the flashlight was being taken in order to prevent damage to their light sensitive surfaces



This is a rather simple Baird televisor designed for home use. It may be used in conjunction with any particularly good radio receiver. The television lamp, on which the image appears, is directly behind the lens, which may be seen within the rectangle at the right of the televisor



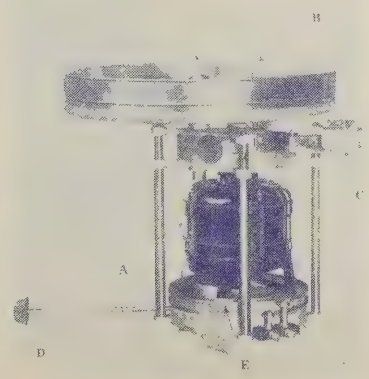
This picture was taken at the Jenkins Television Theatre during a celebration in Jersey City, N. J., where many demonstrations of successful television transmission and reception were witnessed by thousands of visitors. The progress of television transmission is indicated in this photograph. The gentleman behind the speaker's table is being televised.

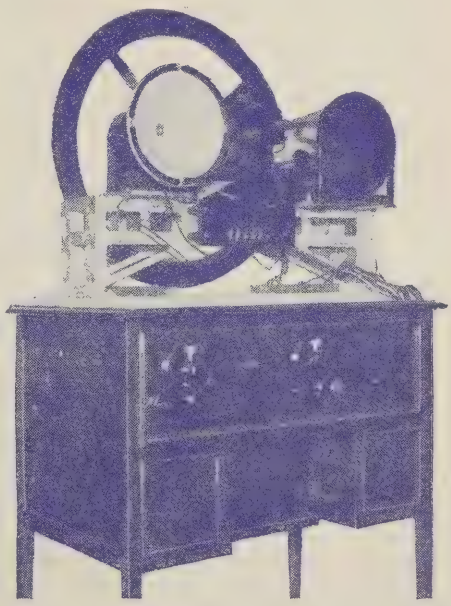
Here we have the interior of the telephone-television booth, with the front wall removed so that the business end of the device may be observed. Directly in the center of the illustration we have the loud speaker while above is the aperture in which the reproduction of the television image appears. Above that is a sensitive microphone used to pick up the speech

This complete television receiver for home use incorporates the short-wave television tuning unit, the television lamp, and a suitable optical system. The entire unit is not particularly hard to operate and is rather attractive in appearance

(*Below*)

A somewhat different system of scanning at the receiving end is used by the Short-Wave and Television Laboratories in Boston, instead of the customary scanning disc with a number of holes properly disposed upon its surface and operating in a vertical plane. This system uses an upright metallic band provided with suitable holes, and is run by a rather powerful motor mounted in a horizontal plane. The synchronizing device is actuated by a small knob attached to the arm, D





Here we have the interior of the first combination sound-television receiver designed for home use. The radio receiver for sound reproduction is controlled by the dial on the left of the panel, while the television images are controlled by the dial on the right

Current

By Arthur

Fred Kauer, who tells the radio audience of the many uses to which radio tubes are put

ONE of the most interesting program features is a portion of the half hour furnished by the Ceco Manufacturing Company of Providence, Rhode Island, and broadcast every Monday night from eight-thirty to nine o'clock over the Columbia Broadcasting System.

Although this feature is presented in a manner which is understandable to most of the listening audience, it is heavily laden with very constructive ideas which should be of more than ordinary interest to every experimenter, serviceman, radio jobber, radio dealer and manufacturer.

Very few folks realize the tremendous importance the vacuum tube is assuming in almost every phase of modern life. In simple, dramatic, and understandable fashion Mr. Fred Kauer, who delivers these talks, carries to the man in the street a story of these most recent radio developments.

Mrs. Hoover's Auto Radio

For the past few months we have been attempting to bring the possibility of auto-radio receivers to the attention of our readers.

Suitable receivers for this purpose may now be had from about twenty-five different manufacturers and it is also possible to revamp some of the old battery-operated broadcast receivers for automobile installation. Several receiver designs for the home constructor have also appeared in our pages.

It is indeed gratifying to know that the first lady of the land, according to the report from Washington, is a radio-as-you-go enthusiast. Mrs. Hoover's limousine is equipped with a radio receiver which is used when she goes on comparatively long trips.

The type of installation is identical with those now becoming so popular.

Television and Band-Pass Receivers

Two years ago television was given a rather devastating black eye by very optimistic ballyhoo which led people to believe that it would be possible to use television equipment to bring a detailed picture of sporting events directly to their living-room walls with comparatively simple equipment. With the existing knowledge of the art this was, of course, ridiculous. In fact, the very costly experimental apparatus used at that time reproduced so poorly that it would not be countenanced in the cheapest of our newspapers.

The cost of the television broadcasting equipment remains very high and there is much work to be done experimentally as with talking motion pictures by wire or radio. However, some of the commercial receiving equipment now being offered for sale is very satisfactory from the standpoint of reproduction and if a similar advance is made in the next two years, many of the objections to the home television receiver will have been overcome.

The image does occupy a comparatively small space, but this is magnified without a great loss of detail by a suitable lens. It is necessary to use the present type of receiver in a room that is nearly dark. In order to secure the best possible reception a specially designed receiver is necessary which should provide for the passing of a frequency band sixty kilocycles wide.

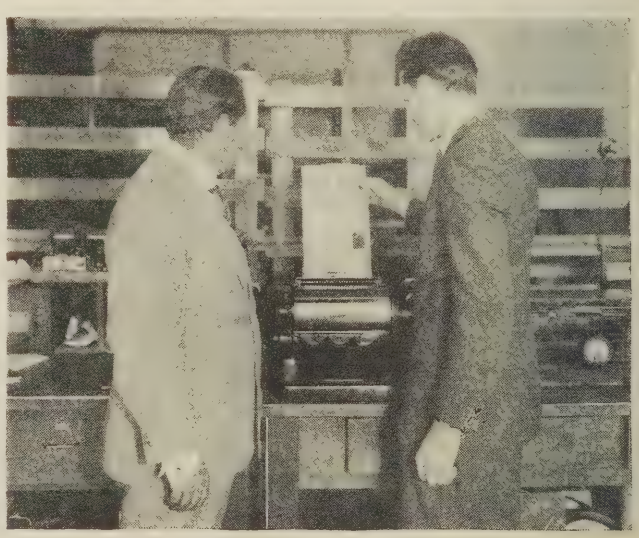
However, most short-wave receivers can be used to pick up television. but the definition will not be as good as those employing the band-pass tuning system. Indeed, with short waves and television there is a marvelous field opening up for the serious experimenter. From now on, we will publish television articles stripped of all the hallucinations which have accompanied them in the past, and entirely up to date. In the publication of these articles we have the helpful coöperation of most of the important laboratories where television advances are being made.

As this issue of RADIO NEWS is being sent to press, we have received additional evidence of the increasing interest in television. A release from Washington states that the De Forest Radio Company has asked the Radio Commission for a construction permit for a television station at Passaic, N. J., using 20,000 watts power and operating at 2,000–2,100 kilocycles. Allen B. Dumont, chief engineer of that company, states that his organization has joined forces with the Jenkins Television Corporation for experimental development work.

Several other applications to the Radio Commission indicate the growing desire of radio manufacturers and others to engage in research work in television. As Mr. Dumont believes, "television is developing very rapidly and no one can tell what will happen within the next six months."

Radio Trade Show

Most of the important radio jobbers and a great number of the radio dealers throughout the country are now at Atlantic



Dr. E. F. W. Alexanderson, at left, and C. J. Young looking at a copy of the newspaper page transmitted by means of the new radio carbon recorder, which appears between them. On the opposite page is a reproduction of the transmitted page

Comment

H. Lynch

City. The Trade Show heralds the beginning of the 1930-31 business. The advance models prepared after months of experimental work are being shown for the first time.

As an indication of the importance of the Trade Show, it is interesting to note that a manufacturer has rented one of the largest piers at Atlantic City for the entire period of the show. Nearly every important window along the boardwalk has been rented. The Atlantic City Municipal Auditorium, which is the largest in the world, is completely occupied and eight thousand more square feet are being used for the Trade Show than any other similar show held in the past.

Special trains carried the delegates and visitors to Atlantic City and an automobile procession, accompanied by police escort, came from New York. Many were equipped with radio.

A description of the recent Albany-New York outboard motor boat race was reported by short-wave radio by members of the RADIO NEWS staff from the Pilot plane

Radio Reproduces a Newspaper Page

Recently three hours after an edition of a San Francisco newspaper had left the presses in that city, persons in the research laboratory of the General Electric Company in Schenectady, N. Y., 2,500 miles distant, were reading the front page. It had been flashed across the country by radio and reproduced in full size in the laboratory by means of a new type automatic carbon recorder.

Radio engineers here declare this is the first time such a feat has been accomplished and predict that as an ultimate outcome radio may soon be delivering a large part of business mail and may eventually bring the daily newspapers direct into our homes.

The device used, which is no larger in size than the average suitcase, can be attached to any radio receiver, much the same as a loud speaker. It prints on a roll of paper which automatically moves through the machine at the rate of about one-half inch a minute. In the experimental tests with San Francisco, a short-wave receiver was used, but only because it was found more convenient so that tests would not interfere with programs on any of the regular broadcast channels. In the experiments a roll of paper eight inches wide was used, which recorded the front page of the San Francisco paper in three separate strips. However, engineers feel they are not limited to this width. The machine is still in an experimental stage. This is the second model that has been made, the first recorded on paper but five inches wide.

WEATHER
THE CALL-BULLETIN
LATEST EDITION
Link Banks in $118,000,000 Julian Plo
WIFE KIDNAPED, BEATEN BY 6 MASKED MEN
WINK COSTS MAN LIBERTY
4 Trapped on Rock Wait Tide
GANG IN AUTO CHOKE, ROB WOMAN
CITIES CLAIM BUSINESS ON UP GRADE
SECRET PHONE PACT SOUGHT
WAVES BLOCK RESCUE OF YOUTHS
BENNETT BARE STOCK TRICKERY
ARRESTS SOLVE 37 ROBBERIES
CENSUS AIDES SEE SUCCESS
FELONS SHOOT 2 GUARDS, FLEE
SEALS, PIRATES

The facsimile transmitter used in sending the page was developed in the G. E. radio laboratory by Dr. E. F. W. Alexanderson. It is located in the company's short-wave radio station, W6XN, at Oakland, Calif., and transmits on a wave of 17.3 meters. The Alexanderson directional antenna is used, such as was developed for the radio broadcasts to Admiral Byrd at Little America. This increases the transmitted signal strength about twentyfold. Reception was made at the company's experimental station in Glenville.

Reporting Sporting Events from the Air

The beginning of the outboard motorboat racing season was heralded by the race from Albany to New York for the now famous Haynes-Griffin Trophy. Through the courtesy of the Pilot Radio and Tube Company we were able to follow this race in an aeroplane and report its progress by short-wave radio to the receiving stations operated by the New York *Times,* the De Forest Radio Corporation, the New York *World* and the RADIO NEWS laboratory.

The pilot of our plane was Bill Alexander, who flew the same plane to Bermuda a short time ago, and the third member of our crew was Zeh Bouck, who is managing editor of one of our sister magazines, *Aero News & Mechanics.*

In all probability, outdoor sporting events such as this will, within a short time, be followed by those of us who cannot see the entire event even though we may be at one of the best vantage points.

Telegraph Code Still Important

A great many of us have the idea, as a result of the tremendous growth of radio broadcasting and radio communication by speech, that the need for understanding the telegraphic code is rapidly passing away. This view is entirely erroneous.

The fact of the matter is that there is more real need for a working knowledge of the telegraphic code now than there ever was before.

Radio communication between airplanes in flight is carried on much more effectively and also with much greater precision with less power by the code method.

In fact, it sometimes becomes necessary to use at least ten times as much power for voice communication as is required for radio telegraphic communication, and the latter, though apparently slower, becomes faster because it is less likely to be misunderstood and requires less repetition. This is also true of communication in almost every field and, even though many folks believe otherwise, the number (*Continued on page 77*)

WHAT PRICE *Remote Control?*

To-day, Remote Control Installations Are One of the Most Profitable Jobs for the Custom-Set Engineer. Applicable Particularly to the Many-Roomed House or Apartment, Servicemen Are Coming to Recognize the Large Field for Remote and Automatically Controlled Radio Installations

By **Milton B. Sleeper***

DID you ever see Gluyas Williams' cartoon picturing a line of people, each with the index finger extended, approaching a post bearing the sign "Wet Paint"?

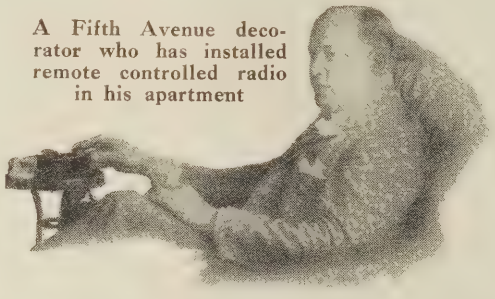
When you have had a little experience with remote control in your home, your friends will give you that same impression. Or if you are selling this equipment, the picture of your customers will be the same except that each will have his check book held out in the left hand.

There is an irresistible fascination about remote control that you can't conceive, actually, until you have found out for yourself by your own experience. Then you'll realize that here is a piece of radio merchandise which can be sold regardless of the price asked for it, merely because the thrill of having it is worth whatever it costs.

And if that seems exaggerated, let me tell you that we do not solicit installations which cost less than $2,000. There is no cabinet cost in such jobs, either, for the chassis is simply enclosed in a perforated steel case, and hidden away out of sight. Nor do such outfits include phonograph equipment or amplifiers.

There are not more than four contractors in this entire country who know how to put in special remote control installations, simply because others have not had the experience necessary to do this work correctly, and these have learned at much expense to themselves.

Two examples of many kinds of mistakes which have cost much will suffice here. A very fine installation was made in a big Park Avenue duplex apartment. Everything was perfect until the outfit was ready to operate. Then it was found that the motor-generator—the current supply was d.c.—had to be turned on at the closet where it was set up. The owner pounced upon that immediately, and insisted that he must be able to switch the generator on or off from any one of the fan control boxes.



A Fifth Avenue decorator who has installed remote controlled radio in his apartment

Such a switching arrangement is customary, but the contractor had built, at great expense, a special set, and forgot to provide the multi-point generator switching control.

When that change had been made, the owner complained of high background noises, and pick-up from all the refrigerators and elevators. The contractor, accustomed to a.c. power installations, did not know that interference is always worse in d.c. sections, and had installed a set with unusually high r.f. gain. He had to change the set to cut down the r.f. gain, because only in that way could he get rid of man-made static.

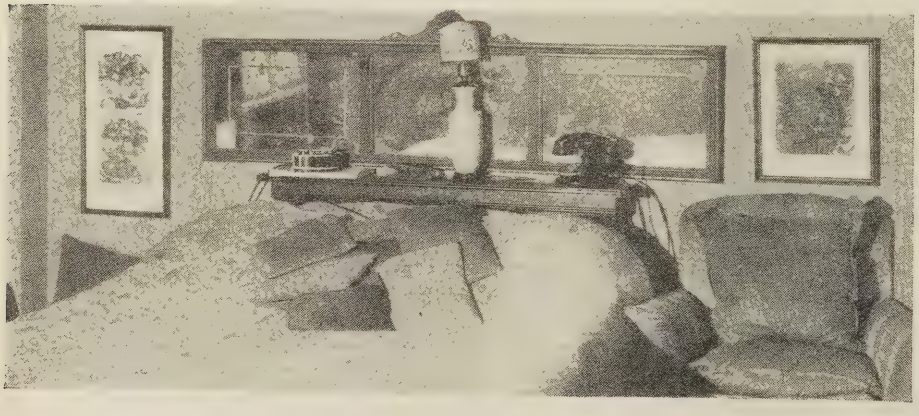
Frequently a customer wants remote control for the radio, and for an automatic phonograph also. This can be done, but it is a trick to tune the set and adjust the volume, switch the set on and off, switch from radio to phonograph, start the phonograph motor, and reject the records from three to six different rooms, all by remote control. Such installations bring up to $4,000 or more.

This work is not easy, nor can it be done by less than highly skilled and highly paid workers, for such prices call for perfection in every least detail. On the other hand, it is better to do a few jobs running into thousands of dollars rather than sweating over service work for people who argue that the price is too high, no matter how small it is.

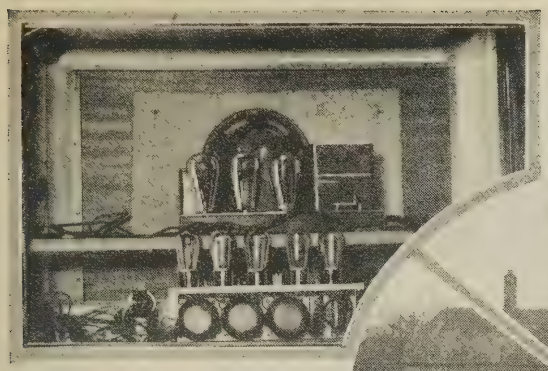
And bear this in mind—in the smallest town there always are a number of people who will spend anything for what is better than anyone else has. If you don't know how to meet such people, tell the president of your bank what you have to offer, and ask him to help you to present your proposition to the right man. When you have finished, you will probably have the president of the bank for your first customer.

Also, don't hesitate to offer

*Sleeper Research Laboratories.

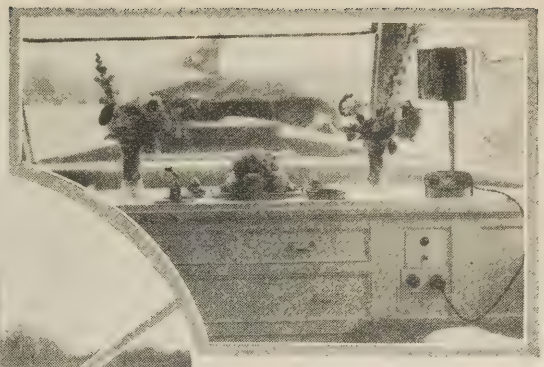


The bedroom of the apartment, showing the inconspicuous remote-control device at the left end of the table. To the right, the receiver, an NJ-30 located in a cupboard, showing the driving motors mounted on the rear of the receiver chassis

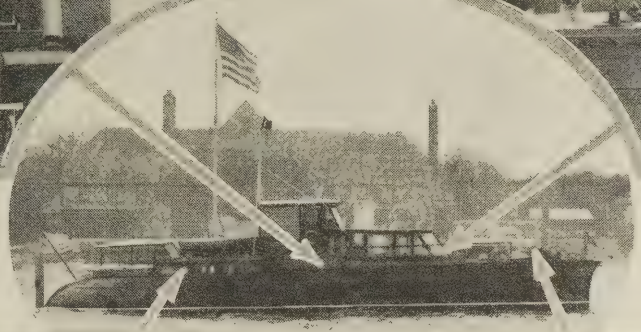


Above the refrigerator is mounted the receiver, dynamic speaker and remote controlled motors

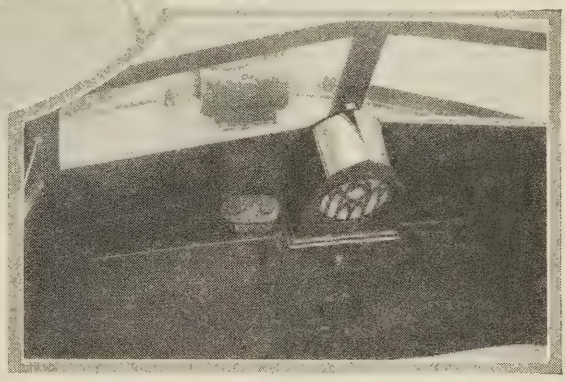
Radio in the forward cabin is easily provided by the wall outlet plate, to which is connected the remote-control device



In the forward cockpit a speaker and remote control offer the only evidence that the boat is equipped with radio



Above, H. P. Whitney's 82-foot *Aphrodite*, which is equipped completely with remote controlled radio. To the left, the master's cabin, showing an overhead speaker and remote control



him a small commission for helping you. He'll take it!

Talking to an engineer who has handled much installation work, he said to me, "People don't want remote control. What they want is to have a good radio set with several speakers around the house, each with its own volume control."

In reply, I asked, "Did you ever see a remote control installation in a home, or talk to anyone who has it?"

He said, "No, but I don't think remote control is so hot. People want several speakers. What does it amount to if you have several speakers and only one control box?"

He was partly right. People usually do want several speakers. However, he thought that it was only possible to have one control box, which was entirely wrong. Our experience shows that many people are satisfied with one speaker, but they always require three or more control boxes.

This misconception is probably due to the fact that many articles have been published describing controls which can be operated from only one point.

We have learned that when a customer says that he wants only one control box and only one speaker that we must furnish a set installed in such a way that other controls and speakers can be added. Here is an instance. An outfit was installed at Forest Hills, Long Island. Mr. Jones-Brown gave the order. When the set was put in, he asked for one box with a cord long enough to reach the living-room, the dining-room, and up the stairs to one of the bedrooms. Accordingly, fifty feet of cord were furnished.

Shortly after the installation engineers left, Mrs. Jones-Brown came home. She saw, with dismay, the big coil of wire. Not in her home. No, sir. So early the next morning Mr. Jones-Brown was on the phone. "My wife won't stand for all that loose wire. What can we do?"

The answer was to put in permanent wiring to three boxes for the three rooms. Apparently the speaker downstairs couldn't be heard well in the bedroom, for Mrs. Jones-Brown soon asked for a speaker upstairs. "And can you put one in the maid's room on the third floor?"

Yes, that was done, and individual volume controls were suggested, but the slight extra cost seemed a little too much. Hence the distress call: "When I want to go to bed, if I tune down the set to suit me, it isn't loud enough for the children downstairs. What can I do? And the maid complains that the radio disturbs her when she doesn't want it."

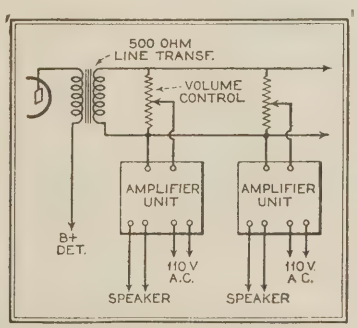
The obvious answer was the original suggestion of putting volume controls at each speaker. It was easy to do, because the whole installation had been planned for these changes in the first place. Otherwise, if the owner's ideas in the beginning had been taken as final, the remote control job would have been criticised as inadequate. We knew, better than the customer, what he would demand when he found out what he really wanted, and planned for him.

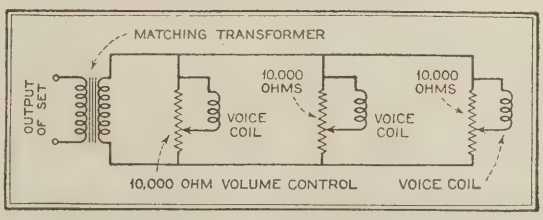
When you are engineering a remote control installation, don't make it Eighteenth Amendment style. I mean this: Ask a customer how many stations he listens to and he will probably say, "Oh, I just want four or five of the good locals." Give him, then, a pre-selection remote control that will tune to eight or ten stations and within a week he will complain that he hasn't half enough choice. His style is cramped. He only wanted four stations, but he kicks the minute he is positively limited to eight. It's the radio version of the Eighteenth Amendment.

Remote control isn't a substitution of buttons for a tuning dial. The kind of remote control that brings $4,000 for an installation must provide dial tuning, volume control at the set, to give the best quality, and power switching to turn the set on or off at each control box.

In other words, real remote control is an extension of the controls of the set to as many convenient points as are required.

A special (*Continued on page* 84)





Above, a circuit showing how separate amplifier units may be connected to the radio receiver's output. Below, the details of a circuit providing volume control for paralleled speakers

George Fleming, known to RADIO NEWS readers for his contributions on test equipment and further information on Loftin-White systems of audio amplification is shown here, in the L-W Laboratory, making measurements on a typical direct-coupled amplifier

More Data *on* Cascaded *for* Direct-

The Information Presented Last ling Devices for Use in Loftin-White Amplification Employing –45 and Here by Additional Data Which menters and Servicemen Who the Demand for Large Amounts

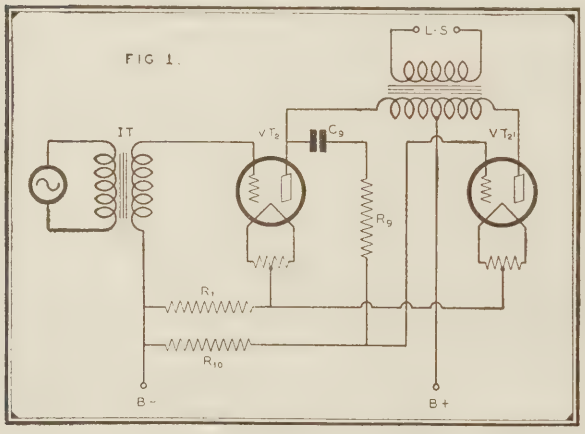
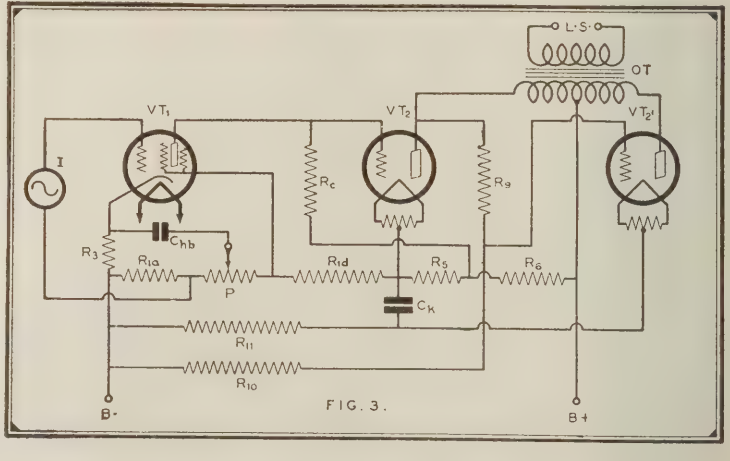


Fig. 1. Applying the cascaded output system is not necessarily restricted to direct-coupled audio-frequency amplification, as is shown in the circuit above

Fig. 3. The details of a direct-coupled audio amplifier circuit with cascaded output system applied. The values and lettered parts are listed in the text

OUR preceding June RADIO NEWS article left us obligated to our readers for further details in the matter of the output system devised by us to obtain some of the benefits of common variety push-pull output systems, so that in this seventh of our RADIO NEWS series we continue with practical details of our devised system. In order to give the arrangement a name, perhaps temporary, with which to refer to it as we proceed, we term it a *cascaded output system.*

The fact is that the two output tubes of the system have their inputs operated in cascade fashion and their outputs in push-pull fashion and, as a result, give some most unique and quite remarkable results.



Our cascaded output system is not limited to use with direct coupling, as is made obvious in Fig. 1, in which transformer coupling to the input circuit of the output system is shown by way of example. For simplicity only the two tubes of the output system are shown. The input transformer, which may be supplied with signal current from any form of preceding

By Edward H. Loftin and S. Young White

Output Systems Coupled Amplifiers

Month on Suitable Output Coup- Systems of Direct-Coupled Audio –50 Type Tubes Is Supplemented Will Be of Distinct Aid to Experi- Build These Amplifiers to Meet of Undistorted Output

system, is of the ordinarv type without center tap, and since it delivers full secondary potential to the grid of tube VT2, the over-all gain of the system is not immediately halved, as occurs in connecting for push-pull operation.

Principal output tube VT2 delivers signal energy into the left one-half section of a conventional center-tapped primary of a split section output transformer OT, though a choke and condenser output system may be employed. Auxiliary or supplementary output tube VT2¹ has its plate connected to the outer terminal of the right one-half section of the output transformer. The system is connected to the B+ and B— terminals of the energizing source as shown.

A particular feature of the system is the method of impressing signal energy of proper amplitude and phase upon the grid of auxiliary tube VT2¹ to cause its output signal energy to properly coöperate in output transformer OT with the output signal energy of principal output tube VT2.

There are at least three more or less simple ways to obtain properly phased signal energy for the grid of VT2¹; that is, 180° from the phase of the signal energy on the grid of VT2. The particular way shown in Fig. 1 is from an anode-to-cathode connection for VT2 through condenser C9 and resistances R9 and R10. R9 and R10 are relatively high resistances compared to R1, so that the signal current difference of potential across R10 determines almost exclusively the signal current potential impressed on the grid of VT2¹. By choosing the relative values of resistances R9 and R10 any desired percentage of the amplified output potential of VT2 can thus be selected for the grid of VT2¹—that is, a potential gradient of signal energy for the grid of VT2¹ is available.

As alternatives, the desired phase of grid potential for VT2¹ may be secured from a resistance connection from anode of VT2 to anode of VT2¹, or from a preferably higher resistance connection from anode-to-grid of VT2 alone. Each of these methods of connection will give different characteristics in the output results. As in the case of the connection of Fig. 1, the alternative connections also permit of selecting any desired percentage of amplitude of potential from the amplified signal output of VT2 for the grid of VT2¹.

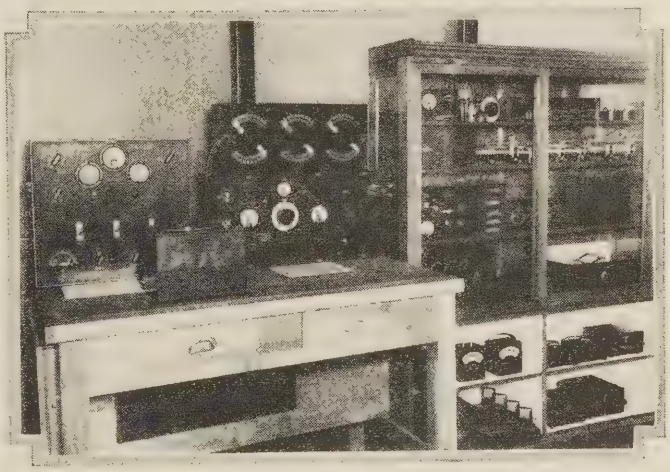
There are two points of signal current potential selection in the available potential gradient of output tube VT2 which offer particular interest. The first is that one which impresses upon the grid of VT2¹ approximately the same signal potential as is received on the grid of VT2 from input transformer IT, so that both tubes produce about the same strength of output signal in their respective halves of output transformer OT. This may be accomplished by making R9 double the resistance value of R10, so that the signal potential developed by R10 for the grid of VT2¹ is about one-third the total output potential of VT2 in the case of the –45 and –50 type output tubes. These type tubes amplify about 3 times, so that the output energy of each is about the same.

In practice, obtaining the ratio is not a critical operation, and can be easily checked by inserting an audio-frequency voltmeter between B+ and the cathodes. Best adjustment is indicated by minimum a.c. potential between these points, and with a reasonably strong signal a balance can be obtained to the neighborhood of 1%; that is, if a signal is impressed upon the system strong enough to maintain 200 volts across the output, there can be obtained a balance between B+ and cathode having a residual of but 2 to 3 volts, which slight unbalance has no noticeable effect on the reproduction, and may be due to an unbalanceable harmonic.

The amplifying ability of the cascaded output type of system in our experiences proves to be from about 5 to 7 times the amplifying ability of the ordinary push-pull system when using the –45 and –50 types of tubes. We immediately gain a factor of 2 over ordinary push-pull by not halving the input signal potential, and the cascaded auxiliary tube VT2¹ seems to bring in another increase factor dependent upon its mu, being from 2½ to 3½ for –45 and –50 type tubes.

Because of the high series resistance of R9 and R10 compared to the impedance of the output transformer OT, very little output signal energy is taken away from the output transformer for this exciting of the grid of the auxiliary tube VT2¹. Since in Fig. 1 the condenser C9 gives the effect of a capacity coupling between the output of VT2 and the input of VT2¹, R9 and R10 must not have sufficient resistance to introduce a blocking effect in condenser C9, but we are helped in this respect by the output

(*Continued on page* 74)



Another view of the Loftin-White Laboratories. It is here that much of the experimental work leading up to the final development and perfection of the direct-coupled amplifiers was accomplished

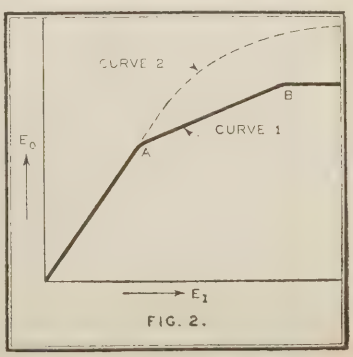


Fig. 2. Two curves tending to illustrate the overload or saturation characteristics when operated under the conditions as outlined in the text accompanying

MAGIC *by* Radio

Mr. Dunninger, world-famed magician and psychic investigator, is pointing to the magic-radio receiver equipment, housed in a sound-proof box. The transmitter is shown spread out in its harness on the table

Magician discloses secrets in giving constructional details with which he has startled many audiences

By Dunninger

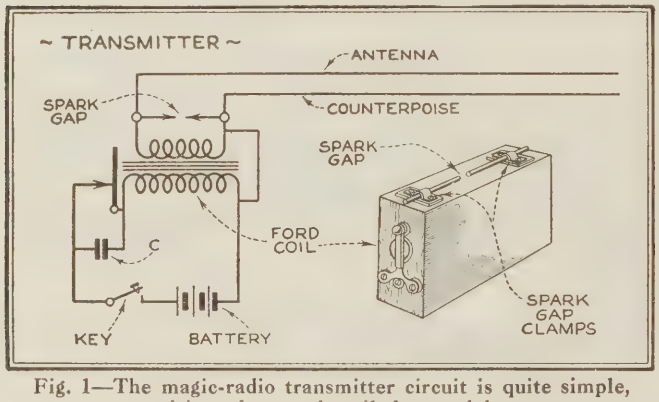


Fig. 1—The magic-radio transmitter circuit is quite simple, comprising of a spark coil, key and battery

MANY applications have been made of radio and probably one of the most interesting is its use in performing feats of magic. By means of radio you can make a horn blow, a bell ring, a flashlight glow, or the replica of a human hand move without any visible means of a directing force. You can also make the lower jaw of a skull move up and down and you can produce many other fascinating effects by means of very simple radio apparatus.

If you are at all ingenious in making such simple pieces of apparatus as are here described you will be repaid many times by the fun and real entertainment which you can give your friends. The description which follows will tell you exactly how to build the apparatus.

There are two parts to the apparatus, namely, the transmitter and the receiver. The transmitter consists of a flat Ford spark-coil such as is used in Ford automobiles and together with a battery and switch or key, some length of wire and a harness with which to hold the transmitter, the transmitter unit is completed. Some of the accompanying photographs illustrate the way in which Mr. Dunninger has mounted the transmitting apparatus in such common things as a lady's pocketbook, which houses the spark coil itself. The receiving apparatus will be described in detail later on.

Here is what you will need to construct the entire radio magic outfit. First, a table of about three feet wide by four feet long, and one preferably having a drawer in it. You will have to construct a harness which will be used to support the transmitting apparatus. This harness is strapped to your person supporting the spark coil and batteries at the small of the back. Then you will need the transmitting apparatus itself, namely, the key, batteries and coil, together with some lengths of wire which will function as antenna and counterpoise.

For the receiver you will need a clockwork mechanism which will be explained in detail later, and two magnets such as bell magnets. Also you will require a number of dry-cell batteries with which to operate the various pieces of apparatus. Then too, you will need a drum, an automobile horn, a skull, a hand and a light. The skull and hand may be fashioned from papier mâché, or if these cannot be readily made then you will have to resort to the novelty store for such things as falsefaces for the skull. For the hand it will be quite all right to obtain an old glove and stuff it, being sure to place therein a piece of metal which can be actuated or attracted by the magnet which is used to operate it. Then, you will need a coherer, which is simply a glass tube which is filled with iron filings and stopped at each end by a piece of metal rod which fits snugly into it. Further details on coherer construction may be obtained from any elementary radio textbook.

How the Apparatus Works

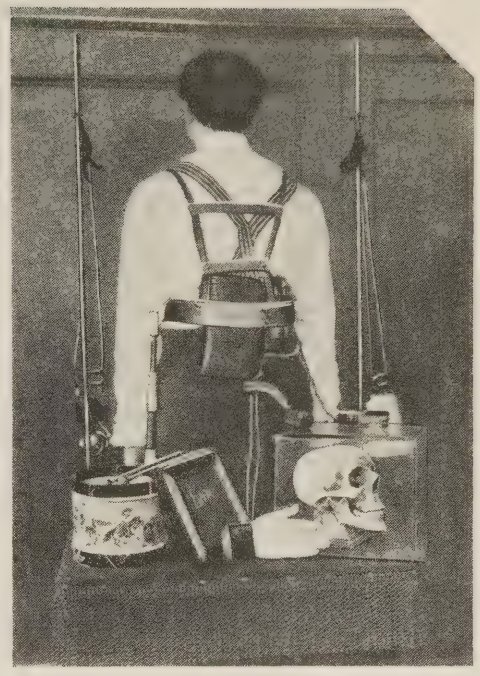
The coherer is very similar to the detector tube in an ordinary radio receiver. It allows the signals which are received to actuate the clockwork mechanism and the various relays and magnets, so that the horn can blow, the drum can be beaten, the light can light, and so on. If you will look at Fig. 2 you will see that the table legs are either hollowed out or have

Here Mr. Dunninger shows how the transmitter is strapped to his body. He is holding, in his left hand, the transmitter key and the selector switch in his right

JOSEPH DUNNINGER, Chairman of the *Science and Invention* Psychical Investigation Committee, is well known, not only for his skill as a magician, but also for his exposes of spiritualism practised by quack mediums.

Frequently he has demonstrated that the seeming production of spiritualistic phenomena is, in many cases, only fraud and the skilled use of clever mechanical contrivances.

Mr. Dunninger here explains for the benefit of Radio News readers how ghostly phenomena may be easily produced, by constructing and utilizing the simplest of radio apparatus.



The magician's table, showing the drum, hand, skull, and the upright antenna table rods for supporting the bell and light

attached to their sides the wires which act as the antenna for the receiver. Notice that the antenna wires are connected directly to the terminals of the coherer, and also that these same terminals connect first to the relay No. 4 and the battery, B1. Now when a signal is received by the antenna wires it is passed along to the coherer, which upon the receipt of a signal, closes the circuit through the relay and the battery B1. This is how it is done. In a state of rest the iron filings in the coherer do not pass any current from the battery B1; that is, the circuit is not complete because the iron filings provide a very high resistance to the flow of the battery current. So when the signal comes along it makes the iron filings tend to adhere to each other or crowd together and thus provide a better path for the current than before by reducing its own resistance. This action, in turn, short circuits or rather completes the circuit and makes the battery operate the relay. Now, when the relay is operated it pulls down the armature which, in turn, closes the circuit through the electro-magnetic release No. 5 and the battery B2. This magnet then operates the trigger release on the clockwork and permits the clockwork to function. Now the clockwork does two things; first, it makes the hammer of the clockwork, which is ordinarily used to ring the bell of the alarm, strike the coherer and disturb the condition of the iron filings, which at the time are completing the circuits; by so striking the coherer it jars the iron filings apart sufficiently to open the circuit for the relay 4 and battery B1. Thus opened, the function of the entire receiver ceases. Another thing that the clockwork does at the same time it is striking the coherer is to close contact No. 8 so that the battery, B3, is made to operate any one of the three effects which can be selected at will by the switch No. 11. Depending on the position of this switch, No. 11, it is possible to successively make the battery B3 operate either the magnet which makes the drum sound, or the horn blow, or the skull or hand move.

The sketch in Fig. 3 shows the details of the clockwork mechanism and indicates how the cogwheel which formerly was used to make the hammer strike on the hour or on the half hour, is altered so as to be operated by the magnet No. 5. In "A" of Fig. 3 we see the queer shaped cam cogwheel which requires one revolution for a complete striking effect. In "B" is shown the type of cogwheel (which is found on other forms of clocks) with the slots in it for striking on the hour and also on the half hour. Where a clockwork is employed which has this type of cogwheel it will be necessary to remove the cog and file down the slots so that all of them are of the same depth.

Going back to the transmitter, it will be noticed that in addition to the Ford spark coil it is necessary to furnish a spark-gap. This spark-gap is connected directly across the secondary of the Ford coil to obtain a spark discharge which is passed along through the antenna and into the air or ether and so on to the receiving apparatus.

As stated before, the entire transmitting equipment is mounted on a harness which is strapped onto your body. The antenna and counterpoise wires are connected in the manner shown; that is, to both ends of the (*Continued on page* 83)

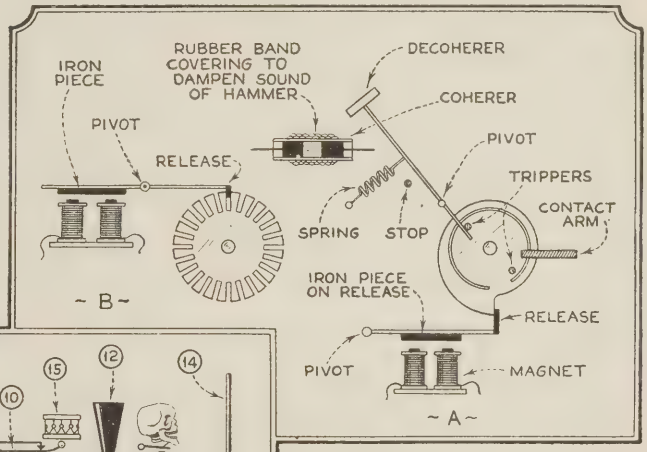


Fig. 3 (above)—Details of the clockwork cog which is fitted up, as shown, to be released by the magnet to cause the hammer to strike the coherer

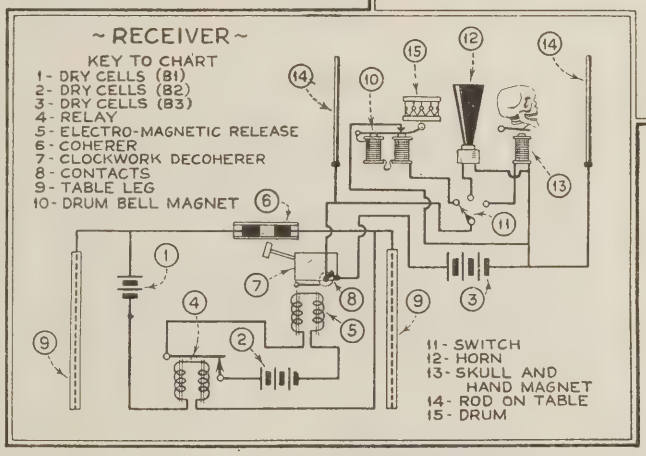


Fig. 2 (left)—This is the complete diagram of the receiving apparatus which is mounted in the sound-proof box located in the drawer of the table

A Non-Technical Exposition of Sound-on-

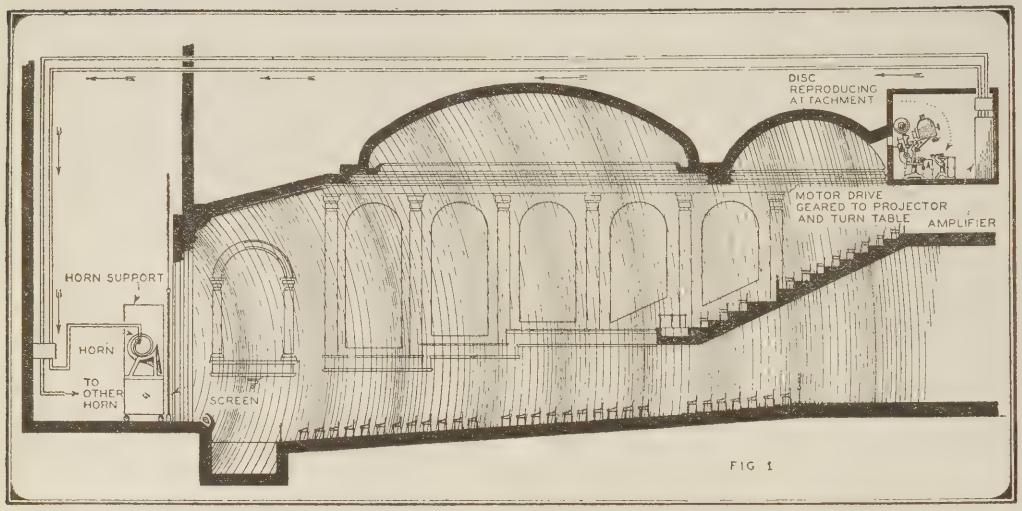


FIG 1

This sketch shows the distribution of sound in a typical theatre. The equipment used in the projection booth and on the stage is shown in Fig. 2

By Fred A. Jewell*

THIS is the second of a series of articles by Mr. Fred Jewell on the allied subjects of sound recording and theater acoustics, prepared especially for radio servicemen who are called upon for this type of work. The next article by Mr. Jewell will discuss sound-on-film recording.

THE first efforts of synchronizing sound with motion pictures was by means of a talking-machine record and this is one method of reproduction that is in wide use at the present time. The first attempts were abortive due to the fact that means did not exist for good reproduction of the sound recorded on the record and the matter of synchronization was impossible, in that the projectors were manually operated and it is humanly impossible to rotate a crank with any degree of constancy.

Electrical recording on discs and electrical amplification of the output of the electromagnetic pick-up together with improvements in the projection of the pictures themselves have brought the state of the talking motion pictures to what they are today. The first talkies shown on Broadway in 1926 were reproduced with the sound-on-disc method and as this method is the older of the two, we are considering it in this second of the series of articles covering the talking motion-picture field.

Let us consider the general layout of the apparatus necessary for the reproduction of talkies by the sound-on-disc method. In Fig. 1 will be found the location of the different parts of the apparatus in a theatre. At the right-hand corner will be seen the projection booth, in which is the projector, disc reproducing apparatus and amplifier. (This being a side view only one set of apparatus is shown, the usual booth equipment includes two projectors and two of the other pieces of necessary apparatus.) Running from the amplifier down to the loud speakers on the stage behind the screen are two sets of leads. In Fig. 2 is shown a general, complete theatre wiring diagram.

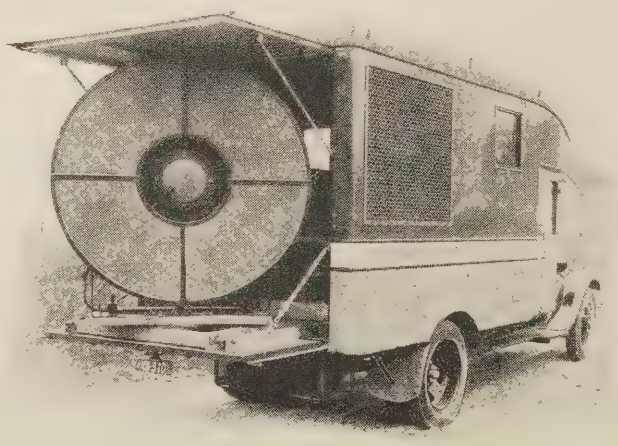
*General Manager, Projectionist Sound Institute.

The Disc Equipment

The first thing that we will consider is the matter of synchronization. The gearing between the projector and the turntable is so designed that the turntable will revolve at the correct speed in relation to the speed of the projector, and as both the projector and the turntable are driven by the same motor, naturally the two will operate in synchronism at all times if they are started at the same instant.

The motor which is used to drive the mechanism is a precision type and the speed is maintained at a constant value at all times. In some cases, a synchronous motor is used and the speed is maintained accurately by the frequency of the alternating current, regardless of the voltage. Other types of motors are used, but always in conjunction with some apparatus which will maintain a constant speed. It is quite essential that the speed be kept absolutely constant in that if there be any variation in speed the pitch of the music will vary.

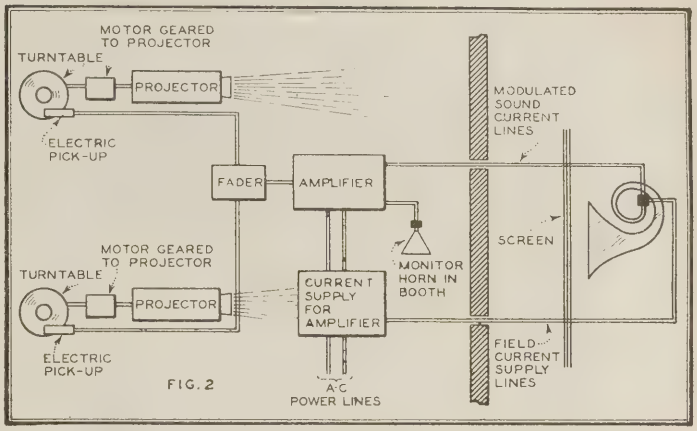
It is obvious that the motor, which revolves at a relatively high speed, is connected to the turntable through gears for reducing the speed of the latter. This connection being mechanical, vibrations and fluctuations of speed are produced. Even when the most accurate manufacturing processes have reduced such disturbances to a point where they would be negligible in ordinary mechanisms, their effects might, in the case of sound reproducing apparatus, be noticeable to the listener as a kind of flutter. The purpose of the mechanical filter which couples the motor to the



The Operadio sound-truck equipped with a bowl type dynamic reproducer for outdoor public address work. Frequently to entertain large crowds phonograph records are played, employing an amplifier system similar to that used for talking movies

Disc Reproduction

Borrowing Freely from the Technique Originated in the Radio Broadcasting Field, Sound Movies Has Advanced with Rapid Strides. Of the Two Main Systems Employed the Record Method Is Simpler to Grasp, Comparing Closely with Ordinary Phonograph Reproduction of Sound Through Audio Amplifiers



A diagrammatic representation of the circuit and apparatus employed in sound-on-disc reproduction for talking moving pictures

turntable by a flexible connection is to absorb these fluctuations in the same way that a shock-absorber eliminates vibrations in an automobile.

Projection Speed

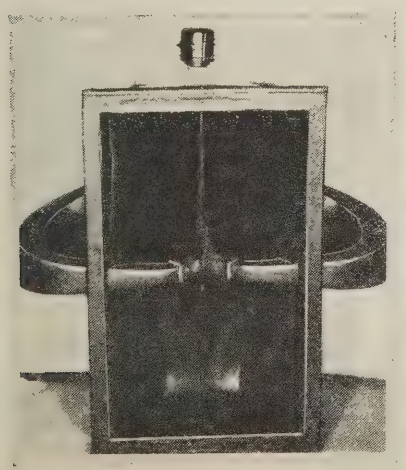
In ordinary motion-picture projection the film is usually shown faster than it was taken, this speed being usually less than 60 feet per minute for silent pictures, at which rate it is run through the projector. In the case of talking motion pictures the film must be run off at the same speed at which it was taken, otherwise the voices or music will be distorted. All synchronous subjects then have to be projected at a rate of 90 feet per minute, which speed must be accurately maintained.

The speed at which the turntable rotates is always 33 1/3 revolutions per minute, which is about half the standard speed of the average phonograph. This turntable speed is produced by the gearing arrangement when the film is running through the projector at 90 feet per minute.

The records that are used in sound projection are similar to the best types of phonograph records in that they are made by the same electrical recording process. However, when a record is made for the talkies the recording apparatus is connected to the camera and the picture is made in synchronism with the sound that is recorded on the disc. The size of the standard sound record is 16 inches in diameter, which is quite a bit larger than the ordinary phonograph record. Usually the playing surface is 3 inches from start to finish for a full record and has 100 lines or grooves cut in it per inch. Therefore, by simple mathematics, we know from the above that there are 300 grooves on the record and as the record's speed is 33 1/3 r.p.m, by dividing 300, the number of revolutions, by 33 1/3, the time required to play the record is 9 minutes. In the same length of time 810 feet of film will have passed through the projector, through which it is traveling at the rate of 90 feet per minute.

Sound records are also different from standard records in that the needle starts at the inside groove nearest the center and travels to the outside rim, instead of starting at the outside and finishing near the center. These records can only be played 10 or 15 times, as they become too worn by the necessary use of a heavy pick-up.

Front and rear views of a "fader," a device employed to switch over from one electrical phonograph pick-up to another without an abrupt change in the volume of the sound coming from the audio channel



To the left, one type of exponential horn with dynamic speaker unit, frequently employed back-stage in talking movie work

The Record and Electrical Pick-Up

If you have examined the grooves of an ordinary record under a magnifying glass you will have noticed that they are irregular and appear to be similar to the track that a snake might leave going across a sand pile. These zig-zag tracks are the sound waves that are cut in the grooves and are for the purpose of vibrating the needle back and forth laterally, as the record travels under the needle point.

The needle that travels in the record's groove is nothing but a mechanical lever which converts the sound waves cut in the groove into mechanical vibrations. The weight and inertia of the pick-up to which the needle is attached keeps the needle point pressed down into the groove, which pressure is estimated to be several thousand pounds to the square inch. Obviously the needle tries to travel in a straight line, but the weight of the pick-up forces it to follow the zig-zag lines, which vibrate the needle back and forth.

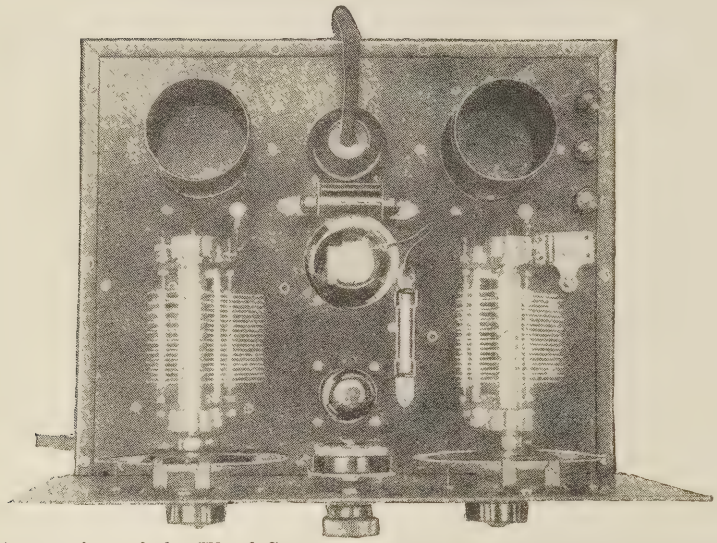
The pick-up, is really an electric generator that converts the mechanical vibrations into varying electric current. The vibrations are transmitted from the point through the body of the needle and vibrates a small armature that is centrally located between the pole-pieces of a magnet. The moving of this small armature changes the magnetic flux in the iron of which the armature is composed and sets up a current in a coil that surrounds the armature. The electric current that is thus set up in the coil is one that varies in intensity in exact relationship with the sound waves that are cut in the grooves of the record.

(*Continued on page* 78)

Constructional Details *of* *The Supersonic*

By Attaching This Two-Tube Converter to Any Broadcast Tuned Intermediate-Frequency self with One of the Finest Receivers Obtainable . . . and A Series of Four Sets of Plug-in Wavelengths from

By Volney



A top view of the Wood Supersonic short-wave adapter, showing the general location of the parts employed in its construction

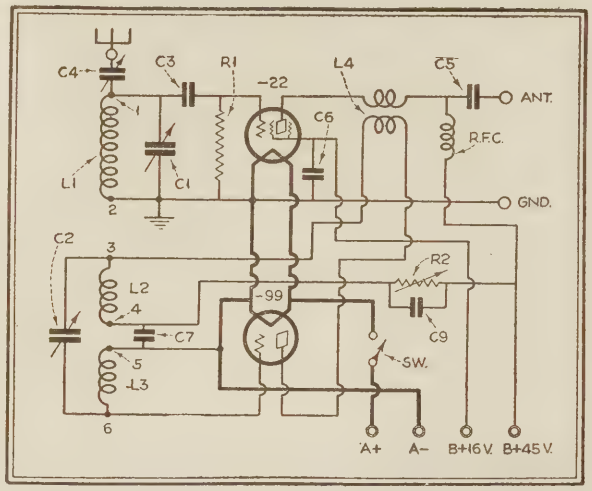


Fig. 1. The circuit of the short-wave adapter, which comprises a detector or mixing tube (-22) and an oscillator tube (-99). The posts at the right marked "Ant" and "Gnd" are those which connect to the antenna and ground terminals of the broadcast receiver

LAST month we discussed the Supersonic idea and its application to short waves. At that time we made the general definition to be applied in our concept of receivers that a Supersonic receiver was one in which the incoming wave is changed to a wavelength in or near the broadcast band of frequencies, amplification at this point eliminating side-band cutting, noises, multipoint tuning on the oscillator dial and giving extreme sharpness, and with the shield-grid tube now available, excellent amplification, as much in fact as one can use satisfactorily. In addition to all this, the relative cost compared to other methods of obtaining even similar results is very much less.

In the short-wave Supersonic the listener is faced with the joyful prospect of being able to use to the full his broadcast receiver in the reception of short waves. This new method overcomes the old adapter idea which seems to have met with very limited success. An adapter merely uses the audio end of the broadcast set and gives problems in so doing. The Wood unit uses the entire broadcast set, r.f. end and all, and in so doing eliminates the bugs in the existing methods of short-wave reception.

To enumerate the problems of the usual short-wave receiver of the regenerative detector type, whether with or without a tuned stage of r.f. ahead, is unnecessary to the experienced readers of RADIO NEWS who by this time know their short waves. Readers of this magazine have been most fortunate in having had the very last word in sets designed along these lines made available to them.

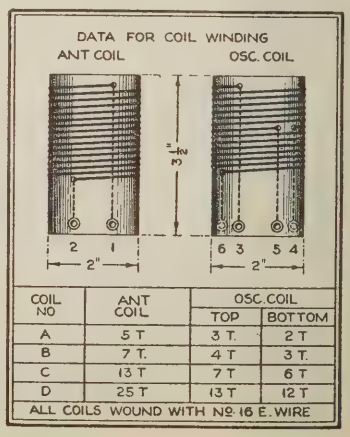
Strangled quality is a characteristic of most of these sets. That's out. Ticklish tuning is also usually encountered. The Supersonic is easy as a broadcast super to tune (one of those few good ones without repeat point, we mean). When the station is in, it's in. Due to the relatively broad intermediate amplifier, slight swinging of the signal is not as noticeable as in the usual short-wave set.

Now that we have discussed some of the good points of this unit, let us describe it. The unit worked out by Manson E. Wood is ridiculously simple, not only from a constructional viewpoint but from that of adjustment and operation. It consists primarily of a short-wave oscillator and a short-wave screen-grid detector. A glance at the accompanying circuit diagram indicates the simplicity of the design.

Its simplicity, however, is the result of a great deal of work by Mr. Wood to reduce it to this point. Starting at the antenna, we come into the detector or mixing tube tuning circuit by a small series condenser which is convenient for fitting various sized antennas to the unit. This condenser can in turn come in at a tap on the coil or on the grid end.

A simple coil only is needed here. This is tuned by a small variable condenser of the 270-degree type, permitting dial action for three-quarters of a revolution. This gives a very desirable separation of stations and provides for easy tuning. The regular condenser and grid leak are connected in the usual manner.

The oscillator circuit is the one which caused the designer considerable



COIL NO	ANT COIL	OSC. COIL	
		TOP	BOTTOM
A	5 T	3 T.	2 T
B	7 T.	4 T	3 T.
C	13 T	7 T	6 T
D	25 T	13 T	12 T
ALL COILS WOUND WITH No. 16 E. WIRE			

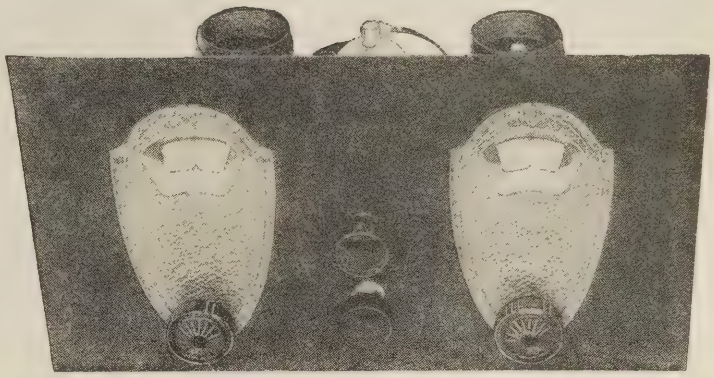
Fig. 2. Four sets of coils, constructed as shown in the table to the right, cover the following wave-bands: A, 15 to 25 meters; B, 24 to 40 meters; C, 37 to 65 meters, and D, 64 to 115 meters

*Radio Editor, *Christian Science Monitor.*

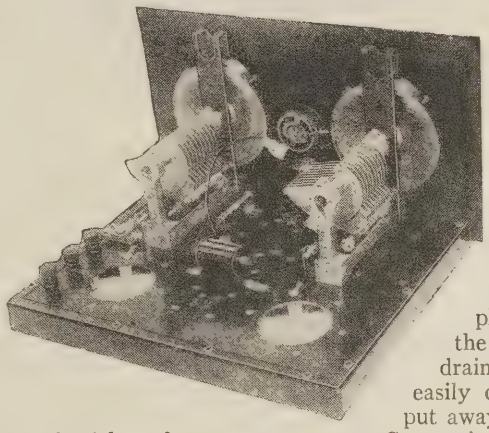
Short-Wave Adapter

Battery-Operated Short-Wave Receiver, Using the Latter as a Amplifier, You Provide Your-Short-Wave Phone and Code It's a Superheterodyne at That. Coils Permit Easy Coverage of 15 to 115 Meters

Hurd*



The front and rear views of the short-wave adapter illustrate its neat and compact assembly



trouble in his development work. In fact, the idea of such a unit is not new, but successful applications of the idea are pretty rare. After many experiments the type of oscillator shown was adopted, the standard Hartley method.

This type of oscillator works out extremely well at about all wavelengths, and is therefore the choice. Now we come to the real trick of the circuit, the method of coupling the oscillator to the detector.

All the usual grid-coupling methods were tried, but at short waves they played all sorts of tricks; absorption points and the tuning of the oscillator affecting the tuning of the input circuit were common faults. Finally the method shown was worked out and proved a happy solution to this problem. As you will note, the coupling is between the plate circuits of the two tubes by a small special coupling coil, or, rather, pair of coils wound on a common form.

The only variable element entering into the unit is the resistance R2, which, by controlling the plate voltage of the oscillator, also governs the amount of energy transferred to the detector. This is particularly useful in clarifying music received from short-wave broadcasters.

While an a.c. version of this can be utilized, it is apparent that for the utmost simplicity separate potential sources should be used. With a 199 and a 222-type of tube the amount of A battery consumption is very small. Two dry cells will last a surprisingly long time. Coming to the B battery, only two very small 22½-volt B's are needed for the unit. The screen grid, on the diagram as C6, is connected to 16 volts plus. With such low B voltages and the other circuit factors, the B current drain is also very small. A small box can easily contain all the batteries and can be put away out of sight.

Connecting the unit to the set is simplicity itself. The connection marked Ant. on the diagram is connected to the antenna post of the set. If you have long and short antenna posts, try each and see which is most effective. The Gnd. connection is connected to the (*Continued on page* 89)

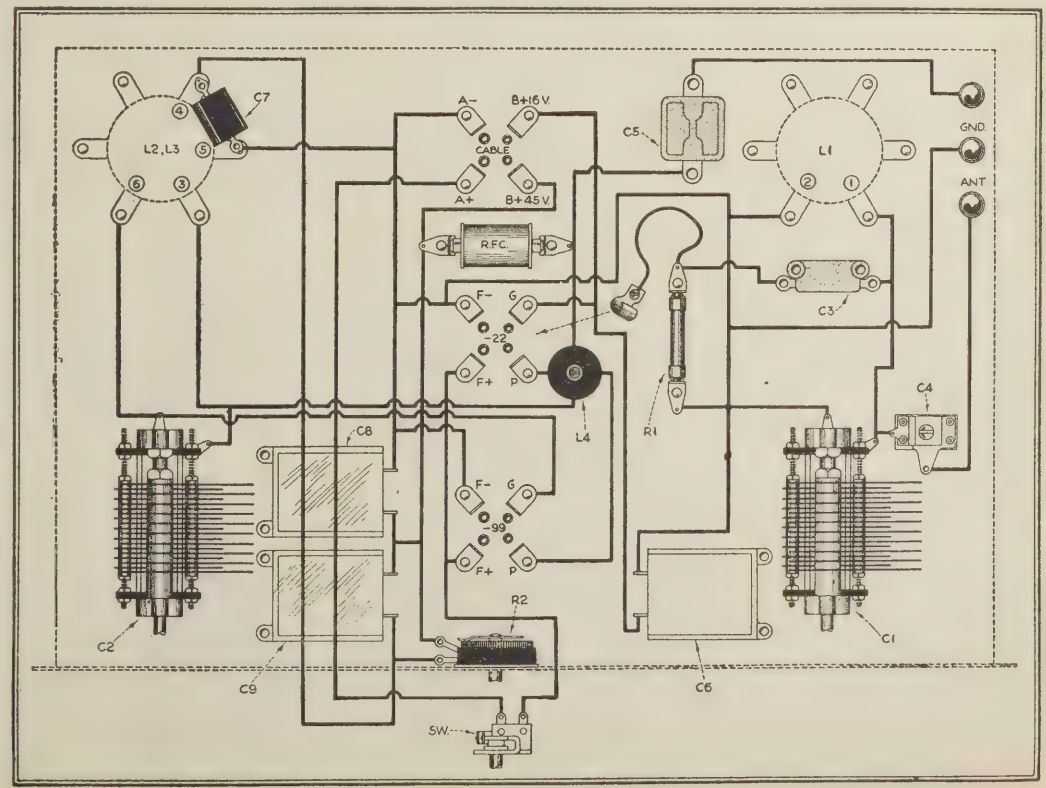
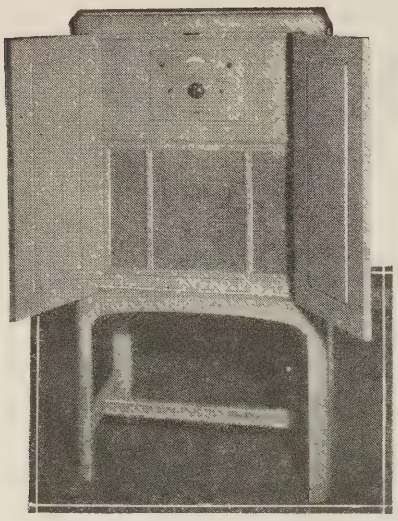
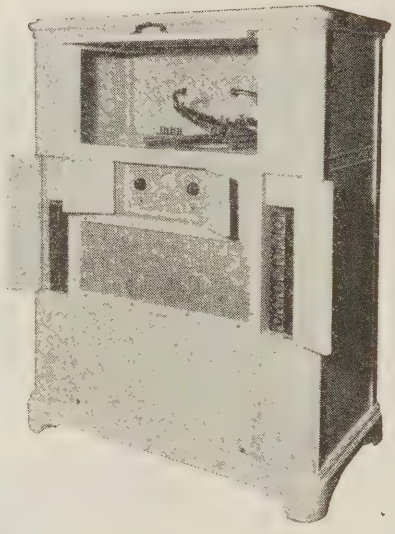


Fig. 3. In this pictorial wiring diagram bypass condenser C8, not shown in the circuit diagram, has been added and is recommended in cases where a greater degree of stability in operation is desired

Practical Remote *for* Serviceman

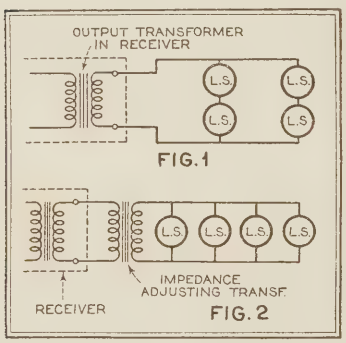




Above is a special speaker cabinet with a remote-control panel built in. At the right is a special bookcase control cabinet radio, automatic record-changing device, speaker and remote-control panel permitting tuning of radio, changing from radio to record reproduction, rejecting of records, etc.

Remote Control of a Radio Receiver at a Point Remote From It Applies Actually to the Volume Control of a Receiver at a Point Remote From It, It May Merely Mean the Extension of Radio to Rooms in the House Other Than That in Which the Receiver Is Located. Both These Methods Are Described Here

FROM the inception of radio broadcasting, the attitude of the public has been one of suspense and anticipation. Back in the days of the crystal detector and the one-tube receiver, radio enthusiasts looked forward to the time when they could dispense with headphones and reproduce the programs through the medium of a loud speaker instead. Then when loud speaker operation was attained, fault was found with the instability, critical tuning and other operating defects. Finally these defects were largely overcome through subsequent developments—then people started looking forward to the elimination of batteries.



Two methods of connecting several magnetic speakers to output of a receiver designed to work into a single speaker of this type. Fig. 1 does not require a special coupling transformer, but complicates wiring. Fig. 2 employs special coupling transformers, permitting all speakers to be connected in parallel, thus simplifying wiring

Today we have the electrically operated receiver with simplicity of operation, plenty of sensitivity and selectivity, and fine tone quality—all of the features to which the public has been looking forward for years.

There will be further improvements in radio receivers, but a good present-day receiver is so close to the ultimate ideal of the average broadcast listener that it can be depended upon to provide years of good service. At the same time, broadcasting is on a sound commercial basis and is of high quality. It would therefore seem that the public can rest from its heretofore continuous suspense and instead devote some thought to the maximum utilization and enjoyment of the radio programs and equipment now available.

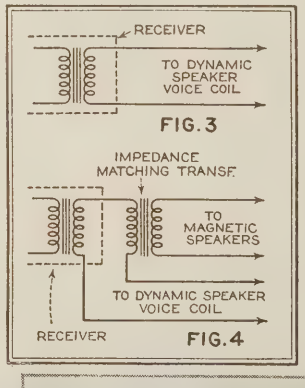
Before going further with this thought it is well to stop for a moment to consider what an important part radio has come to play in home life. In the old days radio set owners were satisfied to use their receivers an average of one or two hours daily, but now it is not an uncommon thing for a radio receiver to be in operation from five to ten hours a day. Almost every family has its favorite programs for each night in the week—and the lady of the house has her daytime favorites as well. Such is radio today and so it will continue, ever becoming a more important home feature.

Under these conditions it seems illogical to limit radio enjoyment to the living-room. If radio holds so much interest for the family, why should its advantages not be extended to other parts of the house, such as kitchen, bedrooms, porch, nursery, maids' rooms, sewing room, laundry and any other rooms where the housewife or other members of the family spend a part of their time? Thus, all of the household could enjoy the programs without the necessity for remaining within earshot of the present receiver. Usually this is not possible when the home is equipped with a single loud speaker, because the volume required to reach upstairs rooms would be annoying to those nearer the loud speaker.

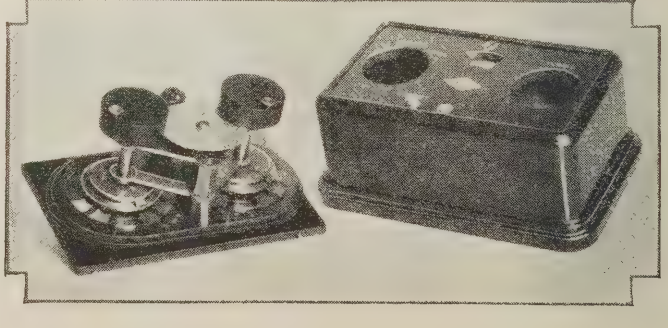
It is a comparatively simple matter to arrange for a loud speaker in each of the more important rooms in the house, using the receiver in the living-room to operate them all. Each loud speaker may have its own switch and volume control so that it can be turned on or off at will and the volume regulated to fit the requirements of the occupant of the individual room.

This presents the simplest of the possible arrangements for extending the usefulness of the radio receiver.

There are additional degrees of convenience and refinement which the system may be extended to include. For instance, it may be a decided convenience to incorporate an a.c. switch in each of the speaker outlets to permit the receiver to be turned on and off from the different rooms in which the loud speakers are located. With such an arrangement the receiver may be left going in the evening until



Figs. 3 and 4. Method of connecting group of magnetic speakers to output of receiver, which also operates built-in dynamic speaker

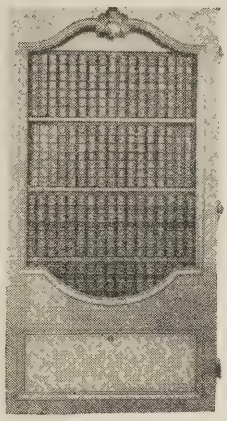


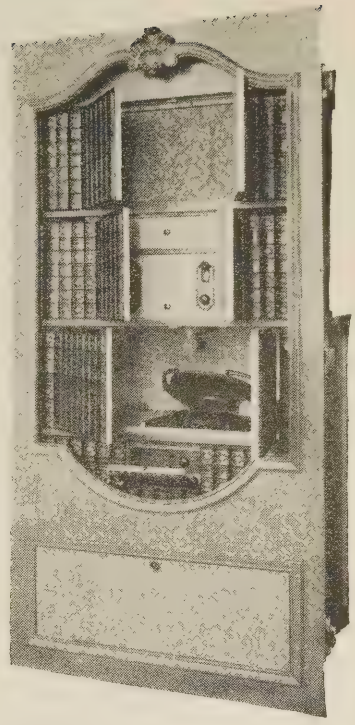
An exposed view of one type of remote-control unit, showing the volume control and tuner knobs with the switch segments which control the motor of the device

Control Systems *and* Experimenter

Receiver Can Mean Two Things. First Switching on, Tuning and Adjustment of Remotely Located from the Receiver. Sec- Piping and Control of the Sound from a Radio Other Than That in Which the Receiver Is Systems Are Discussed in Detail Here

By S. Gordon Taylor





At the left is an example of what can be done with built-in equipment. The door of this bookcase—which was one of four in a room—was removed and false record albums were installed to cover radio, automatic speakers and amplifiers. At the right above is the job completed

the last member of the family is finished with it for the day, and it does not necessitate going down to the living-room to turn it off.

Beyond this, there are still further possibilities. For instance, remote control is gradually being developed to a point where one or more thoroughly practical makes of equipment are now available and others will be shortly. These remote control devices permit the receiver to be tuned from one or more remote points in the house. Some of them make the entire broadcast band available for control from remote points, while others provide only for tuning in any one of several predetermined stations, but do not provide for tuning in stations on other than those few predetermined wavelengths. For most purposes this latter arrangement is quite satisfactory, because there are few homes that listen in on more than a half dozen different stations.

One of the most highly developed permanent home radio equipment systems manufactured makes it possible for any member of the family to sit in his own room and completely control the entire installation. By means of the remote controls which are installed in as many rooms as desired, the radio receiver and amplifier may be turned off or on or may be tuned to any wavelength in the entire broadcast spectrum. Not only that, but an automatic phonograph included in the central equipment is also controlled from these remote points so that an entire group of pre-selected records may be played through, one after the other, even rejecting any undesirable ones; and all this without going anywhere near either the radio receiver or the phonograph. This remote control system is developed to such a high degree of perfection that exactly the same degree of control is exercised from any room as would be possible at the central equipment itself.

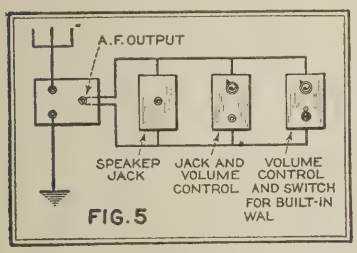
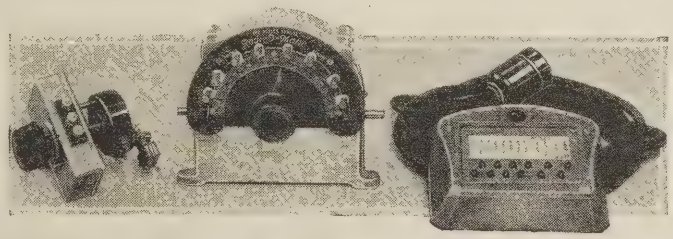


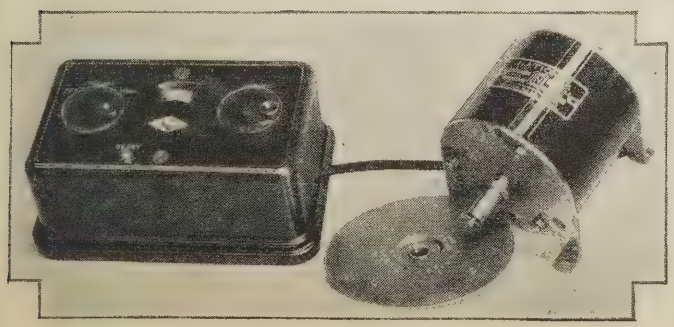
FIG. 5

Other manufacturers are also producing automatic phonographs with remote control box similar to that described and there are several makes of such equipment now available.

The equipment required for a modern home installation will, of course, vary with the requirements of the owner. As far as the receiver and amplifier are concerned, most of the modern commercial receivers will serve admirably for both. A receiver which employs two of the –45 type tubes in a push-pull output stage has sufficient output to operate from twelve to fifteen magnetic speakers at full volume, and twice this number at the volume ordinarily required for individual rooms. If a dynamic speaker is included in the receiver, it will, when operated at normal volume, require from one-quarter to one-half of the output of such an amplifier and therefore reduces the number of external magnetic speakers which can be utilized to approximately eight. This is a sufficient number for most homes, but where more than this number of rooms which are to be loud speaker equipped, it will be necessary to employ a receiver with greater output or to use a separate power amplifier in conjunction with the present receiver.

Fig. 5. Simplest form of permanent home radio wiring, showing different types of convenience outlet. To the right, the Butler remote-control tuning elements, and, below, the Sleeper remote-control box and driving motor





The only problem involved in employing a standard receiver to operate a number of loud speakers is that of matching the total impedance of the loud speakers to that of the receiver. If the receiver is designed to work into a magnetic speaker, then a group of such speakers may be connected in series-parallel so that their total impedance is approximately equivalent to that of a single speaker. In determining the method of connection it is only necessary to bear in mind that when two speakers are connected in series, their total (*Continued on page* 92)

A Volume Control for the Musical Tone Oscillator

This Is the Concluding Article in a Series of Two Describing the Construction and Operation of a Beat-Note Oscillator, Consisting of Two Radio-Frequency Oscillators, an Audio Amplifier and the Volume-Control Device. By a Wave of the Hand Over the Queerly Shaped Metal Hoop Volume Can Be Controlled from a Whisper to Full Output

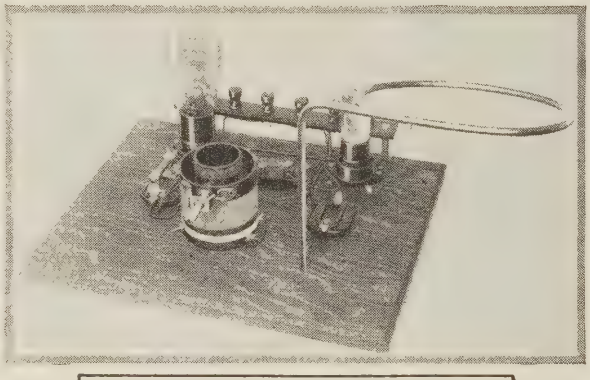
By Joseph I. Heller*

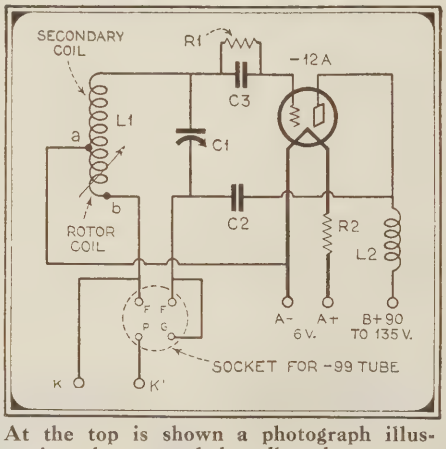
THIS month we are giving all the information necessary for building the volume control unit for use with the beat note oscillator described in the previous issue of RADIO NEWS.

Allow us just a few words of theory and we promise not to get technical any more. It is taken for granted that the reader knows something about what happens when a tube oscillates. If he does not, he should reread several back numbers of RADIO NEWS (25 cents at any newsstand; the writer gets no commission). It will be found in general that all oscillators have a single set of conditions for maximum output. Particularly is this so in the oscillator of the Hartley type, which we are using for the volume control. If, therefore, we should set the oscillator for maximum output, and then vary any one of the constants it will be found that the oscillator output will be reduced. As most experimenters probably know to their sorrow, the grid of an oscillating tube takes all prizes as far as sensitivity to variation and general cussedness is concerned. Therefore we chose the grid of the volume control oscillator as the point for applying the variation. The circuit is shown in the diagram, Fig. 1.

From the photograph it can be seen that the funny-looking loop affair made of brass rod stands up above the rest of the unit. This rod is connected directly to the grid of the oscillator. If the hand should be brought near the loop the shunt capacity in the oscillator will be increased, and since we have previously adjusted the unit for maximum output, the output will, willy-nilly, go down. This last occurrence would not mean anything were it not for the fact that the oscillating current is fed through the filament of a –99 tube and when the output goes down the filament current through the –99 will suffer a corresponding decrease. The plate-to-filament resistance of the –99 will, as a result, be increased. If, therefore, the plate-to-filament circuit of the –99 tube is placed somewhere in the audio amplifier, it can be seen readily that we can govern the output of the audio amplifier by merely moving our hand either toward or away from the volume control unit. The reason a –99 tube is chosen is because of the fact that its filament has a very small mass and will therefore react very quickly to changes in filament current. Reference to the diagram will make the following explanation of parts clear. L1 is an ordinary three-circuit tuner with a variable coil. The secondary and tickler circuits of the coil are placed in series. The part of the coil between "a" and "b" is the tickler coil. C1 is a variable condenser of the midget variety. The one used in our circuit was the X-L type, which is variable by means of screw slot. C2 is a .002 mfd. plate blocking condenser and C3 is the .002 mfd. grid condenser. R1 is a grid leak of about 10,000 ohms and R2 is a 4-ohm filament resistor. L2 is the plate choke. In order to adjust the circuit, connect a 6-volt dial light in place of the filament connections to the –99 and start your oscillator. Vary the rotor coil of L1 until the tube lights with maximum brilliancy. Several sizes of grid leaks should be tried in order to get this point. Now connect the brass loop to point X and bring the hand near the loop while watching the bulb. If no decrease in brilliancy is noted, vary the rotor coil and C1 until the maximum variation of brilliancy is accomplished by moving the hand to and from the brass rod. When the oscillator is working to your satisfaction, replace the 6-volt tube by a –99. Connect the leads marked K and K′ in series with the plate voltage lead to one of the audio tubes and the job is done and ready for test. It may be necessary when testing the apparatus to vary C1 again because one of its harmonics may beat against the frequency of one of the beating oscillators.

Nothing that the writer can say will now make the device any clearer, so we will just leave you to your troubles with a "God bless you, my children," and please don't forget that the writer is not liable for law suits drawn against his readers for maintaining a nuisance. However, the old adage, "if at first you don't succeed," certainly applies here.





At the top is shown a photograph illustrating the general breadboard construction which has been employed in the whole installation, carried through even in the volume-control device. Below is the circuit employed in the volume-control unit

*Chief Engineer, Wireless Egert Engineering Co., Inc.

~RADIO NEWS HOME LABORATORY EXPERIMENTS~

The Radio-Frequency Amplifier What It Is and How It Works

A Complete Non-technical Explanation of the Purpose and Function of That Unit Which Is Placed Before the Detector of a Receiver, the R.F. Amplifier

IN the preceding Home Experimenter Sheet we discussed the antenna, what it is for, and how it works. The figures given in that sheet showed that the antenna circuit is called upon to pick up out of the ether and apply to the radio receiver very, very small voltages—sometimes as low as 5 or 10 millionths of a volt! There are two fundamental reasons why these voltages cannot directly be used to operate a radio receiver. In the first place they are too small for most purposes and, secondly, mixed in with the signal we desire to receive are the signals from many other broadcasting stations. If, for example, we were to connect the proper sort of detector circuit directly in the antenna, we would faintly hear a terrific jumble of signals from all the local broadcasting stations.

We must therefore do two things—select from the many signals picked up by the antenna the one signal we desire to receive and secondly, amplify this desired signal. The ability of a receiver to select a desired signal and reject all other signals is the characteristic we ordinarily refer to as "selectivity." The ability of a receiver to amplify a signal is usually referred to as the "sensitivity". These factors, selectivity and sensitivity, are two of the most important characteristics of any radio set.

We can do both of these things—select and amplify—at the same time or we can *first* completely select the desired signal and *then* amplify it. Most modern receivers combine the functions of selection and amplification. In the tuned r.f. receiver the selecting is done by the tuned circuits (see the April, 1930, Lab. Sheet) connected between successive tubes in the r.f. amplifier. Amplification of the signal is due partially to the r.f. transformers but most of the gain (amplification) is contributed by the tubes. In the superheterodyne type of receiver most of the amplification and selection occurs in the intermediate-frequency amplifier. In receivers in which the processes of selection and amplification are separated use is made generally of a band-pass filter in conjunction with an untuned r.f. amplifier. All the selecting takes place in the band-pass filter and all the gain occurs in the untuned r.f. amplifier.

Since most modern receivers are of the tuned r.f. type we will confine ourselves in this sheet to experiments on this type of receiver. By some simple tests, that can be made with the aid of but little apparatus, it is possible to show the processes of selection and amplification. From these tests the student can get a very good idea of the operating characteristics of the r.f. amplifier—and even though instruments are not available to make the tests a careful reading of the procedure and results will give one a good idea of what happens.

DIAL READING	METER READING IN MILLIAMPERES	POINT NUMBER
15	0.1	A
20	0.1	B
25	0.1	C
30	0.1	D
32	0.15	E
33	0.2	F
35	0.25	G
37	0.2	H
39	0.175	I
40	0.1	J
45	0.1	K
50	0.1	L

TABLE I

Antenna location	Meter reading
Normal—i.e., connected to the antenna post	0.6 ma
Plate of 1st r.f. tube. Point A	0.2 ma
Plate of 2nd r.f. tube. Point B	0.12 ma
Reading of meter with no signal tuned in	0.1 ma

Most of us probably are using some type of tuned r.f. receiver with two or three stages of r.f. amplification. The circuit of such a receiver is shown in Fig. 1. The circuit shown is for d.c. tubes but the essential circuit for an a.c. set is the same. In so far as the following experiments are concerned they may be done equally well with either a d.c. or an a.c. set. It should be realized that we had no desire in these experiments to get very accurate results and, in fact, this would hardly be possible using the methods described. We simply want to get some idea of how the r.f. amplifier serves to select and amplify the desired signal.

First let us try to get some good idea of the selectivity of the receiver. This we can do by connecting a milliammeter with a range of not more than 1.5 ma. between the B plus tap on the power unit or battery and the lead from the B plus terminal of the audio transformer. The location of this meter is shown on the diagram at I in Fig. 1. Now if the detector is of the grid-leak-and-condenser type the meter will read about one or one and one-half milliamperes when the set is turned on and the tuning control is adjusted so that *no* signal is being received. If a C bias detector is used the meter will probably read about 0.1 ma.—one-tenth of a milliampere. The set on which we performed the following experiments used

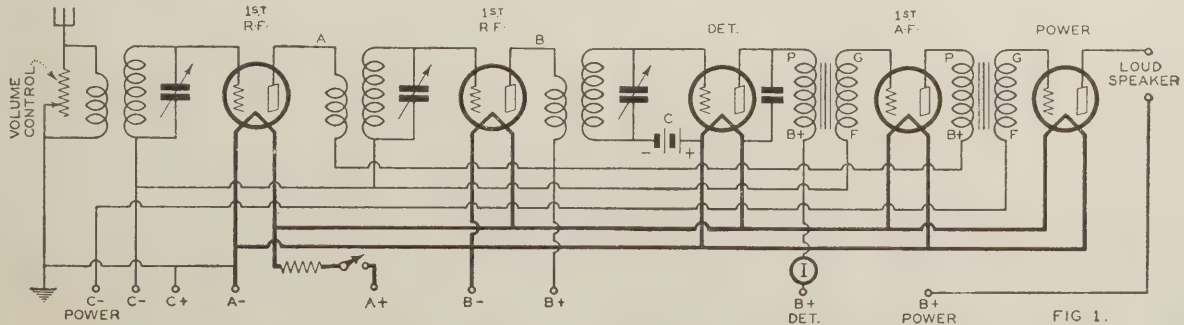
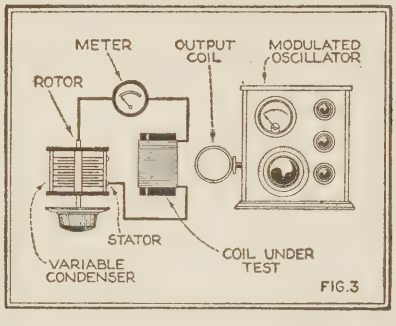
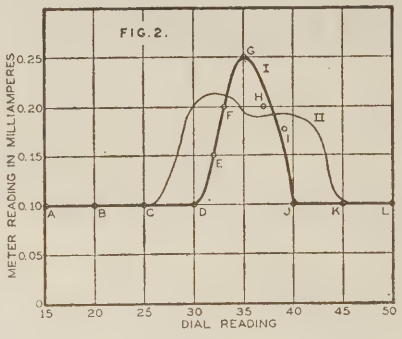


FIG 1.

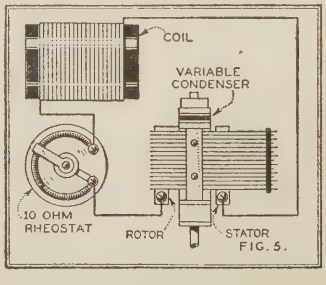
a C biased detector and some relative idea of the set's selectivity was obtained in the following manner:

First we noted the reading of the milliammeter, I, with the set turned on but with no signal tuned in. The meter read 0.1 milliamperes. Now we turned the dial and tuned in WEAF. This station was selected simply because the signals from it were sufficiently strong to give a good indication on the meter. It is important in making these tests that you also use some station that comes in good and loud. On our set WEAF tunes in at 35 on the dial. It is best to start this experiment with a dial reading about 20 degrees lower than the reading at which the station tunes in. Therefore, let's start at, say 15, on the dial. We turned the dial to 15 and found the meter read 0.1. So in the first column of Table I we noted the dial reading and in the second column we noted the current. Then we turned to 20 on the dial, then to 25 and so on, each time noting the meter reading and indicating its value in the table. Until we reached 30 nothing happened but at 31 there was a slight increase and at 32 the meter reading increased to 0.15 milliamperes. At 33 the meter read 0.2 milliamperes. At 35 the meter read 0.25 milliamperes and then at 36 it had begun to decrease again and read only 0.2 milliamperes. This procedure we continued until we reached a dial reading of about 50—that is some 15 or 20 degrees beyond the point where the meter read a maximum. All these readings should be listed as shown in Table I. They should then be plotted as a curve as shown in Fig. 2. Along the lower edge of this curve we have indicated the dial readings and along the vertical left-hand edge are the meter readings. The various points on the curve obtained from the data in Table I are indicated by the small letters a, b, c, and so forth corresponding to similar letters in Table I. Through these points we then draw a smooth curve marked I. If we find some of these points slightly out of line, such as points h and i, we can run the curve between them as has been done in Fig. 2. In the course of this experiment we would have noticed—because in any experimental work one should be sure to make note of every effect—that the program audible from the loud speaker became louder as the meter reading increased, the point at which the meter reading was greatest corresponding to the loudest signal.



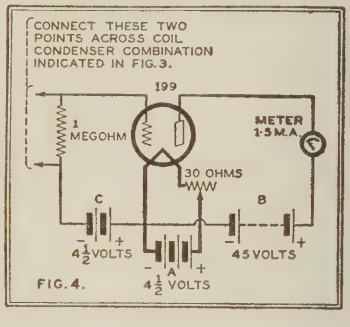


The curve we have plotted in this manner shows the selectivity of the receiver. If the set has very good selectivity, the curve will rise very rapidly—if the selectivity is very poor, the curve will be quite broad. If the variable condensers in the receiver are arranged with setscrews on the rotors so that we can throw one or more of the condensers out of alignment, we can determine how condensers out of alignment impair the selectivity. For example, if a couple of the condensers are thrown out about 2 or 3 degrees and another curve made in the same manner described above, we might get the curve shown as II in Fig. 2. This curve is much broader and the station will be audible over several more degrees than in the preceding case when the condensers were all accurately in tune. The broad curve means poor selectivity due to misalignment of the variable condensers.



The differences between these two curves will immediately suggest to many servicemen that this is probably a good way to line up the condensers in a receiver. That is right and by the use of such a method the condensers can be aligned more accurately than is possible by simply listening to the output from the loud speaker and trying to adjust the trimmers on the condensers for maximum output. By taking several curves on a receiver in the manner described on this sheet it is also possible to determine the form of the curves at say 600, 1000 and 1500 k.c. and determine how closely the condensers keep in step throughout the entire tuning range.

Essentially the same method we have used is followed in a regular laboratory to measure the selectivity of a radio receiver. Of course, very accurate instruments are used and the measurements are made over a very wide range in input voltage to the set. In measuring sets in the laboratory the tuning dial on the receiver is left at a single point and the frequency of the signal applied to the antenna is varied. This is approximately equivalent to working with a constant frequency and varying the dial reading as we did in the preceding experiment.



The sensitivity of the various stages of the r.f. amplifier can also be determined qualitatively by noting the deflections of the meter located in the plate circuit of the detector tube. A simple experimental method of doing this is as follows:

Tune in some powerful local station to maximum volume. Note the reading of the meter. Then disconnect the antenna from its normal location and connect it instead to the plate terminal of the first r.f. amplifier tube, point A in Fig. 1. Again note the reading of the plate meter. Then connect the antenna to point B, the plate terminal of the second r.f. amplifier and once more note the plate meter reading. Making this experiment on a set in our own laboratory the following readings were obtained:

With the antenna connected to the antenna post the entire r.f. amplifier was in use and the gain was a maximum as indicated by the comparatively large increase in current from 0.1 ma (the no signal value) to 0.6 milliamperes. With the antenna connected to point A the first r.f. amplifier tube was, in effect, disconnected from the circuit and the gain was then due to just one tube and its associated r.f. transformers. With the antenna at point B there were no r.f. amplifier tubes in use. The meter readings give a relative idea of the gain and show how the output of the detector decreases as the r.f. amplification is reduced.

If possible, the experimenter should carry along somewhat further the general type of experiments described here. Some tests that might be made are:

1. Determine how the detector plate current varies as the volume control is adjusted. Plot a curve showing the relation between the setting of the volume control and the plate current reading.

2. Set up a receiver and note the changes in plate (*Continued on page* 86)

The Radio Forum

A Meeting-Place for Experimenter, Serviceman and Short-Wave Enthusiast

The Experimenter

A –45 Push-Pull on Batteries

FOR the experimenters who wish to conduct a number of experiments using the –22 tube in a resistance-coupled audio stage, followed by a push-pull stage using two –45's and employing a six-volt storage battery for the filament source, Mr. G. D. Gratton, of Island Falls, Ontario, Canada, passes along the following interesting audio amplifier.

The chief features of this amplifier are that it uses a screen-grid tube, resistance coupled, and two –45 tubes in push-pull. The filament of the –45 tubes being connected in series; it also is well filtered. The filtering is not absolutely necessary, but adds greatly to the tone quality and frequency response, and is well worth the added expense.

The filament consumption is very reasonable considering the power developed, 1.7 amperes "A" battery and 30 milliamperes "B" battery drain. The "B" battery drain given here is when 180 volts are used on the plate of the –45 tube. If 250 volts "B" potential were used, the drain would be considerably more. Referring to Fig. 1, the resistor R1 is in the order of 75,000 to 250,000 ohms, depending on the type of detector used. If the detector is a –22, then 75,000 ohms is the correct value, for the –01A or –12A, 100,000 ohms is the proper value to use and for the –40 the resistor should be 250,000 ohms; R2, five megohms; R3, R6, 12,500 ohms; R4, R7, 25,000 ohms; while R9 and R10, the stabilizing resistors, shunted across the secondaries of the input push-pull transformer, are 250,000 ohms; the filament resistors, R5, 20 ohms, and R8, .6 ohms.

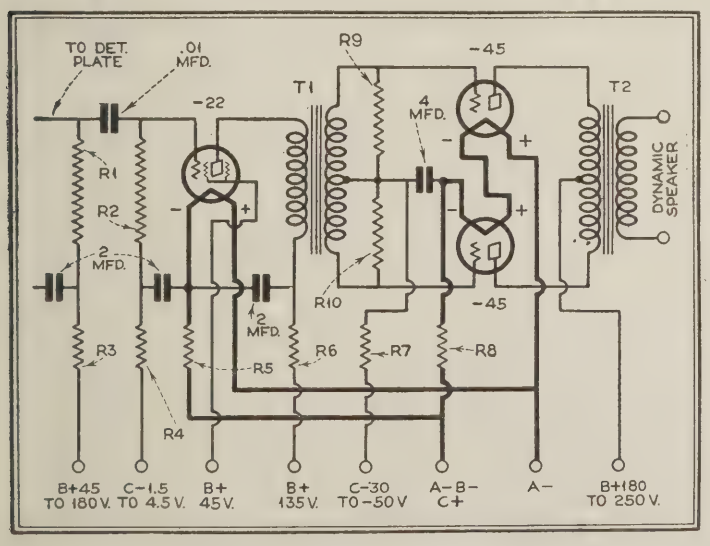


Fig. 1. The circuit diagram of a push-pull audio amplifier for battery operation

It is well to note that the "B" plus 45 to 180 volts is dependent on the type of detector tube employed in the tuning unit. Thirty volts of "B" bias is correct for the –45 tube when using 180 volts on the plate, while 50 volts is necessary when 250 volts are used in place of the 180 volts.

Mr. Grattan is, at present, using this amplifier in connection with a tuned radio-frequency and detector tuning unit. This unit consists of three stages of tuned r.f., employing the battery-operated screen-grid –22 tube and a power detector, also employing a –22 tube. The total battery consumption for this standard circuit tuner and the amplifier is 2.12 amperes for the filament and 36 milliamperes for the plate potential.

Improving the Audio Amplifier

EXPERIMENTERS who desire the nth degree of perfection in fidelity given by the use of resistance capacity couplings, above all, after power (plate) detection, writes Mr. R. Raven-Hart, may find it well worth while to go a stage further and try out the use of an inductance as in A, Fig. 1, instead of the usual grid leak, as in B, Fig. 1.

As is well known, one of the great troubles with resistance-capacity amplification is the tendency of the tube to block on loud signals or bursts of static, due to the fact that the coupling condenser becomes heavily charged and cannot get rid of its charge fast enough through the grid leak. As a result a momentary heavy potential is applied to the grid and the tube ceases to function normally until the charge has leaked off. As remedies, we may decrease the value of the coupling condenser or that of the grid leak. The former alternative has unfortunately the extra and undesired results of reducing the amplification in general and that of the bass notes in particular. The latter reduces the signal strength by wasting the voltage which we need across the grid and cathode.

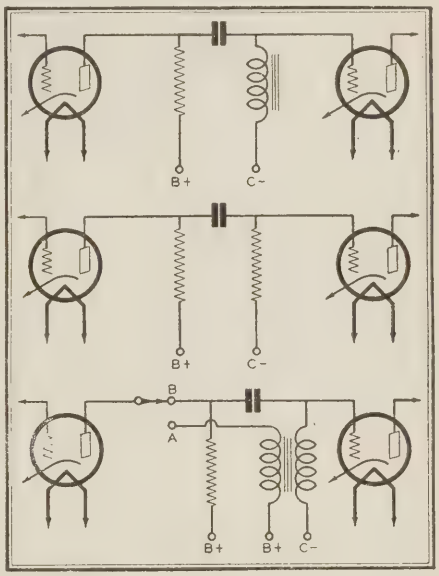


Fig. 2. Circuits A, B and C, respectively

The great advantage of using an inductance in place of a grid leak is that this risk of blocking is practically eliminated, so that as a result larger coupling condensers can be used and therefore better bass note reproduction is obtained without this phenomenon appearing. For example, it is generally considered that with a grid leak of two megohms no larger coupling condenser than .005 microfarads can be used. If we wish to increase this condenser to .01 microfarads, for instance, we must reduce the grid leak to about one megohm and even with these values there is a considerable risk of blocking. If, however, we substitute an inductance for the grid leak, not only will signals be, in general, louder than with the leak, the inductance not wasting so much signal strength, but also we shall usually be able to increase further the coupling condenser (to .1 microfarad, for

(*Continued on page* 86)

The Serviceman

Simplicity and Efficiency in Testers

For the past several years publications devoted to radio have printed directions, specifications and diagrams of various types of test equipment. Some of these units were tube testers for either a.c. or d.c., while others were set testers, working equally well on either a.c. or d.c. But they all seemed to lack something necessary to the serviceman, or the price was prohibitive.

In the following, Mr. Nelson W. Gendall, of Gloversville, New York, describes a piece of test apparatus that performs all tests that a serviceman is called on to make away from his workshop test bench, including alignment, balancing and neutralizing receivers. It will test either a.c. or d.c. tubes, as well as both the –22 and the –24 screen-grid tubes and some rectifier tubes. It will provide meter reading of the filament, grid and plate voltages delivered at each socket, as well as the screen-grid voltages on the newer sets.

All continuity tests can be made and the output of the power devices can be checked. By the use of the oscillator incorporated in the set a modulated signal can be produced which is indispensable in neutralizing, aligning of condensers and balancing. All this can be accomplished at a normal cost.

The panel layout, Fig. 1, is that used in the original layout. It may, however, be varied to suit the individual builder.

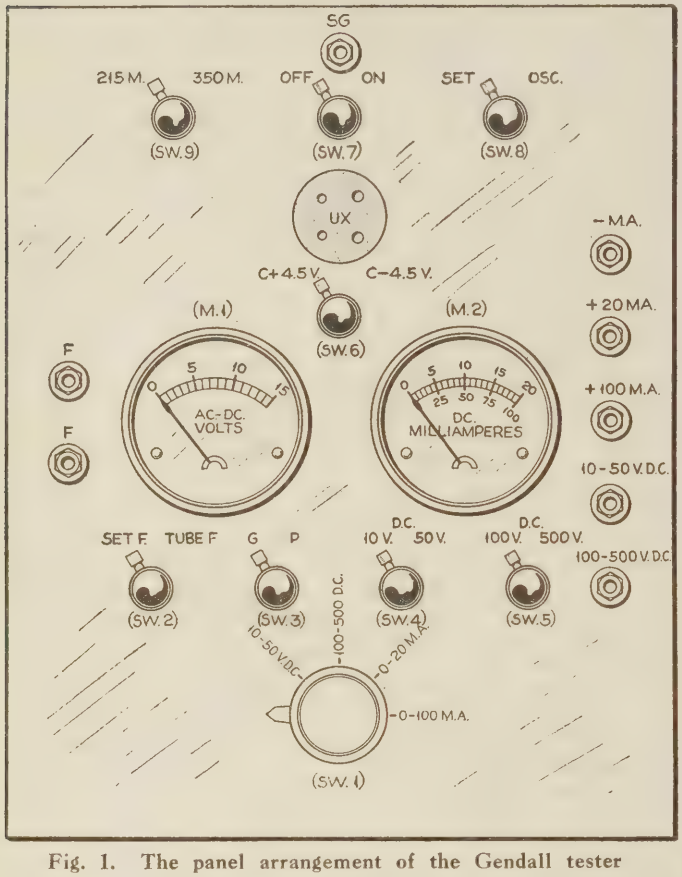


Fig. 1. The panel arrangement of the Gendall tester

The parts to be made by the constructor are, first, the inductance L1. This is made by winding 115 turns of No. 24 enameled wire on a bakelite tube one inch in diameter and two and one-half inches long. This inductance is made with a center tap.

The test plug is made by breaking the glass from an old UX–99 tube and cleaning out the base. After removing the prongs from the handle-cap attachment plug (this plug may be purchased at any electrical supply store), cut it down so it will fit tightly into the tube's base. Drill a 6/32 inch hole in one side of the tube base and pass a short machine screw through it, turning up a nut loosely on the screw, so as to hold it. Now pass the five-wire cable through the handle-cap attachment plug and solder four of the wires to the four tube prongs. The fifth wire is fastened to the machine screw previously placed in the side of the tube base and the nut is tightened. The handle is now forced into the tube base tight enough so that the plug may be removed from the receiver sockets without loosening the handle. The wiring of the cable in the set is shown in the wiring diagram, Fig. 2. The plate and grid wires go to either side of SW3. The filament wires go to one side of M1 and to the center spring at SW2, respectively. The connection from the screw in the side of the tube base is wired directly to J1 and the screen-grid connection.

The next operation is making the two short leads for testing screen-grid tubes. Take about eight inches of flexible hook-up wire and solder a small clip on each end. These clips should be the type that can be put on the cap of the screen-grid tube and removed by pinching. A very small battery clip is ideal for this purpose. The other small lead is made by taking eight inches of flexible hook-up wire and soldering one end to a phone tip, or fastening it to an imp plug. The other end is soldered to a fahnstalk clip and the clip is then opened far enough to allow it to be placed on the top terminal of a screen-grid tube. The test leads are made by taking two pieces of flexible insulated wire, four or five feet long, and fastening an end of each into an imp plug, or a phone tip. The other ends are fastened to test probes.

Instructions for Use of the Instrument

To find the voltages delivered at any socket, remove the tube from the socket and insert the plug, using whatever adapter necessary. It is taken for granted that all switches are in the "off" position before starting to test. Throw SW2 to the set "off" position and the M1 will read the filament voltage being delivered at the socket. To take the grid voltage,

(*Continued on page* 80)

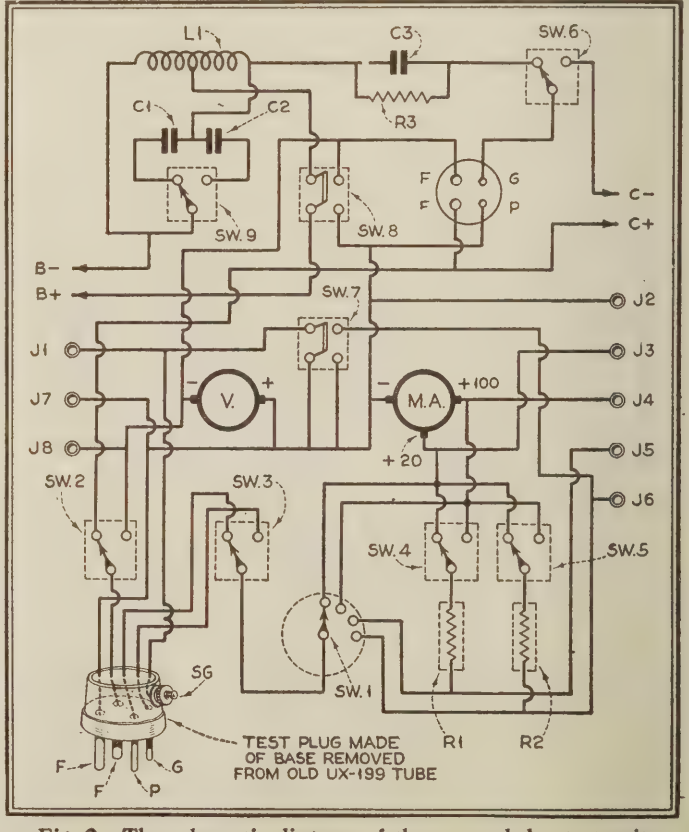


Fig. 2. The schematic diagram of the a.c. and d.c. test unit

Announcing a New,—

Practical, Inexpensive,

TELEVISOR

No larger than a radio receiver - So simply constructed that anyone can operate it

HOLLIS S. BAIRD
Chief Engineer

A. M. MORGAN
President and General Manager

B. F. PERRY
Treasurer

AFTER several years of intensive research and concentrated effort in the field of practical, inexpensive television, The Short Wave & Television Laboratory, Inc., of Boston, Mass., now offers the public the new Baird Universal Televisor. This remarkable new instrument not only reproduces a transmitted image with even greater detail than any elaborate laboratory equipment has ever been able to obtain—it reproduces it with a complete televisor that occupies a space only 15 inches square, and costs no more than a good radio receiver.

Will Reproduce Every Television Broadcast Station on the Air

Moreover, the new Baird Universal Televisor will reproduce the images broadcast from every television transmitting station now on the air. It makes absolutely no difference what type the transmitter—the Baird Universal Televisor, when tuned on that broadcast wave, will reproduce the images it sends. This in itself makes the purchase of the Baird Universal Televisor a sound, practical investment. No other televisor built today has this remarkable advantage.

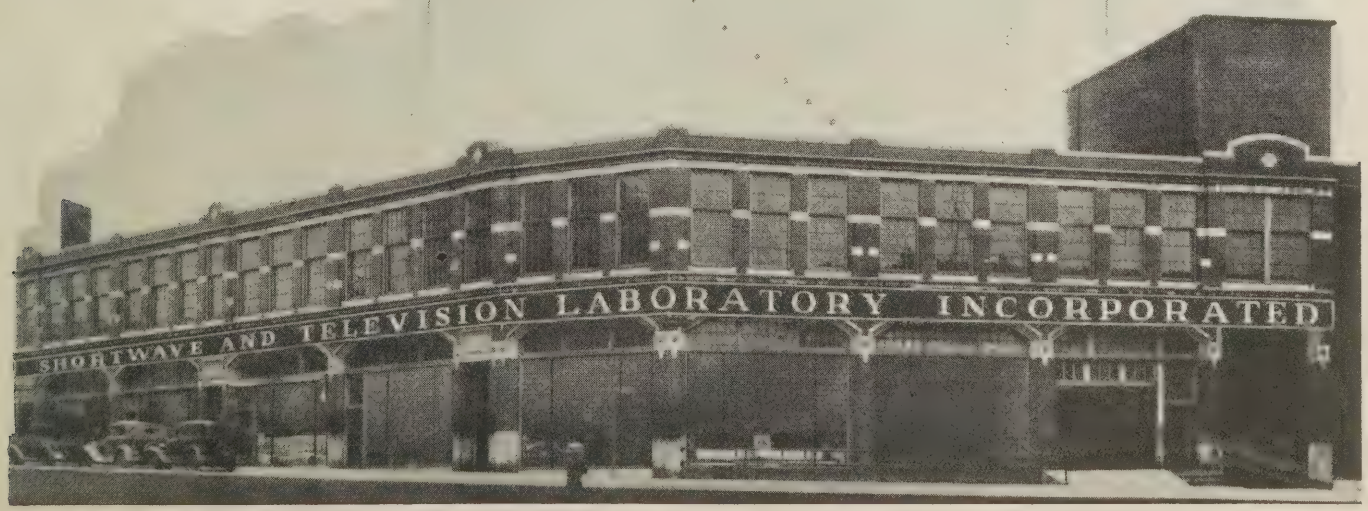
Mr. Hollis Semple Baird, the Chief Engineer of the Short Wave & Television Laboratory, Inc., is the designer of this remarkable new television receiver. Although only twenty-four years of age, his knowledge and experience in this field is excelled by no one. Ever since he graduated from the Massachusetts Institute of Technology, his whole life has been wrapped up in designing this receiver. (See next page for complete description.)

Television Broadcast Stations Everywhere Now

Today there are some twenty television broadcasting stations in the United States. Most of them broadcast regular programs every evening. Prominent stations are located at all the great cities. WGY at Schenectady, KDKA at Pittsburgh and the Radio Corporation of America at New York are now in the air with constantly improving pictures that make television reception a delightful experience and pleasure in any home.

The Short Wave & Television Laboratory, Inc., also owns and operates station W1XAV at Boston expressly for television broadcasts.

THE SHORT WAVE & TELEVISION LAB., INC.
Dept. 40, 64-76 Brookline Avenue,
BOSTON, MASS.

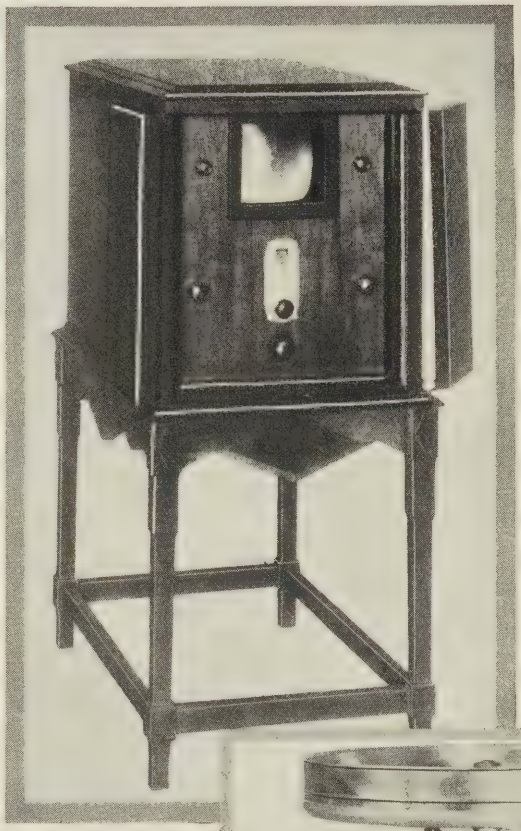


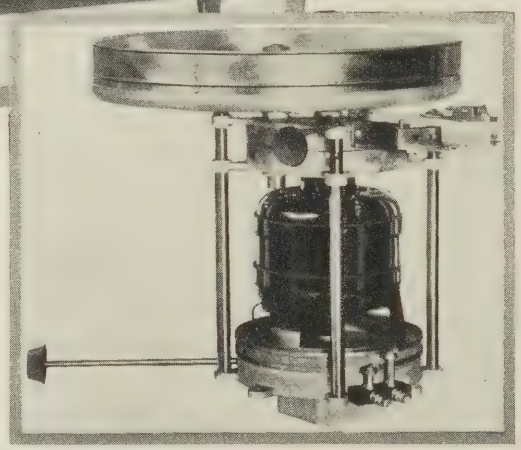
Some Interesting Facts About the New

BAIRD TELEVISOR

Turn the Dial and See Instead of Hear It!

THE Baird Universal Televisor is in reality two units enclosed in the same console, a shortwave receiver and the televisor for viewing the picture. The shortwave receiver which picks up the television signal is located in the same cabinet with the Baird Televisor, the A. C. power pack of which also actuates the Neon lamp. The shortwave receiver has one stage of tuned screen grid radio frequency, a non-regenerative screen grid detector and two stages of resistance coupled screen grid audio amplification feeding into the 245 power stage. Resistance coupling is necessary owing to the fact that a Television picture contains frequencies from 10 cycles up to as high as 40,000 cycles and ordinary transformer or impedance coupling cuts off frequencies above 8,000 cycles. The operation of the Television receiver is as simple as it possibly can be. On the front of the cabinet appears a lens approximately 6″ square, and below this is the tuning dial the same as in the average radio set in the home; a switch to turn your current off and on and a volume control for increasing and decreasing the quality of the picture. The receiver, therefore, is absolutely silent, and after throwing the switch you simply tune the dial until a picture appears through the lens. Then comes the Televisor, the unit of the receiving set that actually receives the picture. This consists of a small synchronous motor that turns a horizontal metal plate called a "spider" which supports a narrow strip of thin steel perforated with square holes, a Neon lamp and a lens.





Even a Child Can Tune It!

The simplicity of tuning the picture in and out is remarkable. There is no more difficulty than there is in tuning in the voice on your regular radio receiver for a local station. In some sections of the country large areas are already synchronized, with the result that there is no trouble in keeping the picture in frame. By that we mean that it is possible for a picture to be broken up when first received so that the picture will not be in the exact center of the receiving apparatus, which condition can be compared to the adjustment of a moving picture machine.

An Ingenious Method for Framing!

We have an ingenious method of bringing this picture into frame in a particularly simple manner. A small knob projects from the front of the cabinet, and by turning this knob either to right or to left it will gradually bring the picture into the proper position. The operation is no more difficult than turning the volume control knob on a radio set which makes your reception either louder or softer. This same framing device is employed in tuning where the Television picture is received from a transmitting station that is not on the same synchronized line as the receiver. This lack of synchronism will have a tendency to make the picture move out of frame, but by slowly turning the framing knob the televised picture can be kept in continual view.

The Only Televisor That Will Reproduce Pictures At Any Speed Transmitted

The twenty or more stations which are today transmitting Television images are using various combinations, such as a 48-line picture with 15 pictures per second, or a 60-line picture with 24 pictures per second. The fact that the Baird Universal Televisor is so constructed that it will take any and all of these speeds makes it efficient to the point where it will get any Television signal on the air. This is an extremely important factor, as if it were not so designed the receiver would only be capable of getting one signal and no others.

Baird Televisor Kits

The radio technician desiring to build his own Television receiver can obtain the Baird Televisor Kit, which is almost exactly the same apparatus as is installed in the finished receiver shown here. Kits, of course, are offered at much lower prices, as the work of assembling must be done by the purchaser. Complete blueprints and constructional drawings come with each kit. Write today for complete information and prices. Use the coupon.

The Short Wave & Television Laboratory, Inc.

Dept. 40, 64-76 Brookline Avenue
Boston, Massachusetts

Gentlemen:

Please send me your Big 32-Page Booklet illustrating and describing the new Baird Universal Televisor with prices on both the kit and Cabinet Model.

Name .....

Address .....

City ..... State .....

The Short Wave & Television Laboratory, Inc.

Dept. 40, 64-76 Brookline Avenue
Boston, Massachusetts

On Short Waves

A Two-Stage R.F. Short-Wave Receiver

Short-Wave Editor,
RADIO NEWS,
Sir:

About one year ago I purchased a National Short-Wave kit for the construction of a short-wave set for use in the tropics, and while it has performed exceptionally well, the volume was not what I desired, unless three stages of audio amplification were used, two straight and one push-pull with –71A tubes.

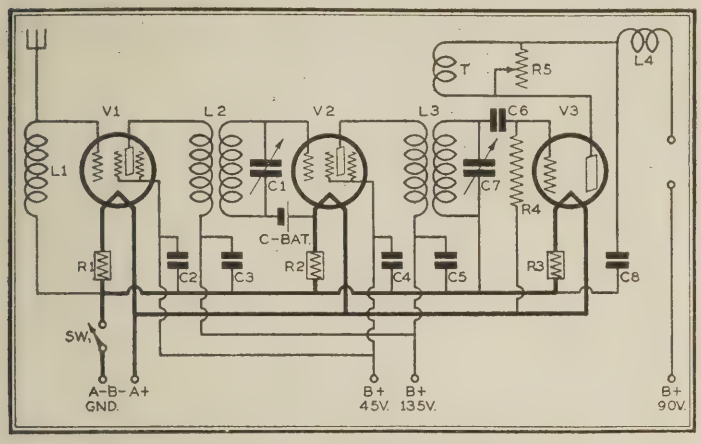


Fig. 1. The circuit diagram of the two-step short-wave receiver

The result of all this audio amplification was distortion of tone and it occurred to me that the amplification of the signal ahead of the detector (r.f.) was the answer to tone and volume. While in the United States recently I purchased another National kit and have combined the two kits in the circuit Fig. 1.

This circuit proved to be the answer. During the past two months I have experimented with various circuits, using National parts, such as tuned impedance, traps, etc., but the circuit here to be described, seems to be the best.

While the set, to my mind, is still incomplete (in that it does not have complete shielding, or by-passing by chokes and condensers, etc.), it provides plenty of volume and fine tone, using two stages of straight audio amplification. Even without the shielding and chokes it has hair-line selectivity and good over-all gain. However, experimental shielding of coils and tubes shows that slight gain in volume and the insertion of chokes in the battery leads will, undoubtedly, vastly improve the performance of the set.

The heart of the set is the construction of the coils used and transformers. The winding of the primary with very fine wire between the turns of the secondary seems to be the answer to handling high frequency in conjunction with –22 tubes.

The audio amplifier can be any good amplifier. My own consists of one S-M 225 first-stage transformer with a –12A tube and one S-M 226 second-stage transformer, with two –71A tubes in parallel, the output going to an inductor type dynamic speaker.

I am forwarding this information thinking it may be of interest to the many short-wave fans. With the circuit diagram Fig. 1 and the base panel layout Fig. 2, I am sure that no experienced constructor will have any trouble in duplicating this set and the excellent results that I have obtained with it.

Very truly yours,
CHARLES E. OSTERHOUDT.
Maracaibo,
Venezuela.

Schedules

The following is the schedule of short-wave broadcast transmission of radio stations belonging to the Royal Siamese Post and Telegraph Department, Bangkok, Siam:

Station HS1PJ —16.9 meters— 20 kilowatts of power:

On Sundays—From 12 to 14.30 and 18 to 20 G. M. T.

On Tuesdays—From 13 to 15 and 18 to 20 G. M. T.

Station HS4PJ—37 meters—200 watts:

Fridays—From 13 to 15 G. M. T.

Reception reports of these broadcasts may be reported to the radio chief at Bangkok.

Radio Conditions in England

Short-Wave Editor,
RADIO NEWS,
Sir:

Unlike the United States, England has not as many high-powered broadcasters, though what is termed the regional scheme will, if all goes well, supply the listeners in Great Britain with satisfactory reception. At the present time two of these stations are operating. They are 2LO in London on 261 meters and 358 meters. These two stations come in with terrific volume and at the present time very few sets are selective enough to separate them. However, like in America, we will have to get used to them. On a large antenna with screen-grid radio-frequency stage, followed by a detector and pentode, I can receive stations on adjacent wavelengths to those of the London stations with ease. It is possible with a receiver of this type to pick up most of the European stations, several in North Africa as well as stations in Turkey, Asia and India.

Of the stations in the United States, the following come in best: WGY, WBZ, WJZ, WGN, WLW, WPG, WIOD, WEAF, KGO and KOA. All of these stations have been received regularly since 1928. During 1929 I have been able to add WTIC, WSAI, WABC, WENR and WLS to the list.

Excellent results have been obtained on short waves. The following stations are received with reasonable regularity: BK-3LO, 2ME, 2BL, 2FC, PK-PLE, PLF, PLG, PLR and other Javan stations, as well as two Japanese stations, one on 31 meters, the other on 28 meters. From Canada—CFA, DGA and DJRX. While from Africa—FK-7LO; Buenos Aires, on 15.02 and 43.9. From the United States the trans-Atlantic radio telephone, W2XG, WMI, WML, WND, WNC, WNB, W2XO, W2XK, W2XAD, W2XAF, W2XAW and W2XAC. The majority of these stations, of course, have been picked up on the loud speaker.

While carrying on a number of experiments on a small rowboat only 10 feet in length, equipped with a 6-foot mast, I have been able to receive W2XK, W2XO and W2XAD.

I have also received GLYK, Colonel Millard's motor yacht *Adventuress* while it was cruising within the Arctic Circle.

LESLIE W. ORTON,
Willowbank, Uxbridge, England.

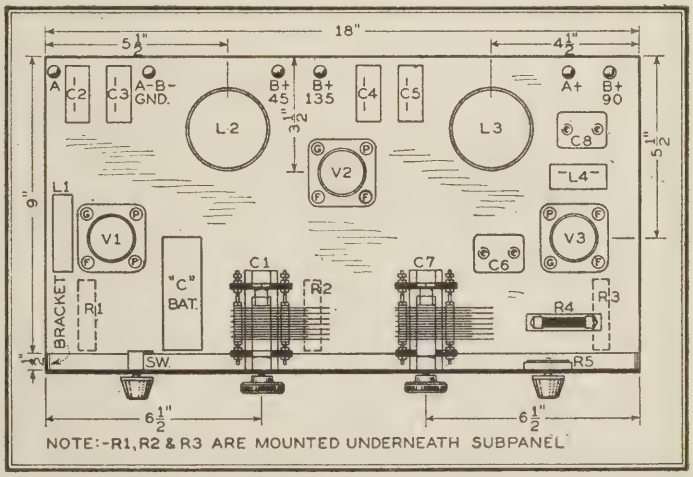


Fig. 2. The sub-panel details of Mr. Osterhoudt's receiver

De Forest Experimental Station Increases Power

The power of the De Forest Experimental radio telephone station W2XCD, at Passaic, N. J., which has become familiar to many broadcast listeners who occasionally wander down to the bottom of their tuning dials, is steadily being increased. New equipment is being developed and is installed for increased power

(*Continued on page 82*)

RADIO NEWS INFORMATION SHEETS

By Elmore B. Lyford

Power Amplifier Tubes

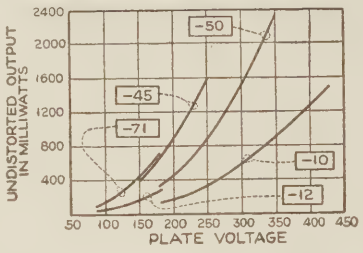
Index No. R-333.2

THE choice of the correct power tube to use in the last audio stage of a radio receiver depends upon the power we want to deliver to the loud speaker, the maximum of plate and grid voltage which will be available, and the signal voltage we expect to feed into the tube. The accompanying table and graph give this data about the more common types of power tubes.

The first thing to consider is the maximum undistorted power output which we shall want. This may be anything from around 250 milliwatts (to drive a magnetic-type speaker at room volume) to 1,000 or 2,000 milliwatts (1 or 2 watts, to drive one or more dynamic speakers at auditorium volume). It may be seen from the graph that the −12, the −71 and the −45 will all satisfy the first condition, but that only the −45, the −10 and the −50 will satisfy the second.

The choice also depends upon the plate voltage supply available. If a maximum of only 180 volts is at hand, for example, the chart shows that the −71 or −45 will perform equally well, and that either will be preferable to the −10 or −50 at this voltage.

TUBE TYPE	GRID BIAS	PLATE VOLT.	MAX. POWER OUTPUT (MILLIWATTS)
−12	4.5	90	30
	9.0	135	120
	10.5	157	195
	13.5	180	300
−71	16.5	90	110
	27.0	135	330
	33.0	157	500
	40.5	180	710
−45	24.0	157	420
	33.0	180	780
	36.0	200	920
	50.0	250	1600
−10	12.0	180	145
	18.0	250	340
	22.5	300	600
	27.0	350	950
	35.0	425	1500
−50	45.0	250	900
	54.0	300	1500
	63.0	350	2350
	70.5	400	3250
	84.0	450	4650



As between the two tubes most suitable in the case just mentioned, the choice would rest upon the impressed signal voltage which they will be called upon to handle. This is approximately equal to the grid bias, as shown in the table. At 180 volts plate, this value is 40.5 volts for the −71, and 33.0 volts for the −45. If the impressed signal voltage never would exceed 33.0 volts, the latter tube would be the one to use, but if the grid voltage might exceed 33.0 volts, the −71 would be the tube to use, for it is capable of handling the higher voltage of the two.

All this data is based on the use of a single tube in each audio stage. In the case of push-pull stages, the grid circuits of the tube may be considered as being in series, and the plate circuits in parallel. The allowable impressed grid voltages, therefore, can be twice as much for a push-pull stage as for a single-tube stage, and the output may also be considered double that obtainable from a single tube.

RADIO NEWS INFORMATION SHEETS

By Elmore B. Lyford

Inductance Charts—Part 1

Index No. R-230

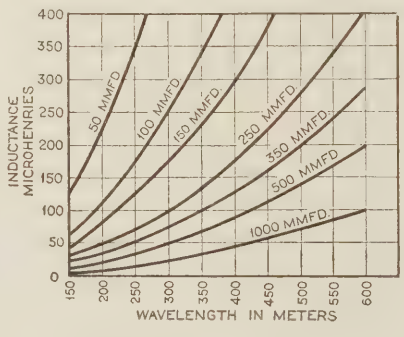
INDUCTANCE coils, shunted by condensers to form tuned circuits, find varied and important uses in radio work. They are the tuned circuits in our receivers, they are our wave meters and wave traps, and they make up our filter circuits.

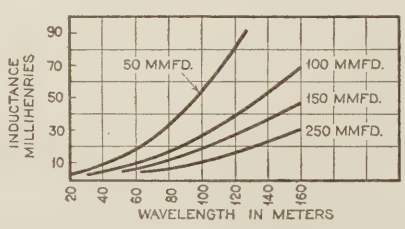
With any given condenser value, the inductance which will be necessary for use with it to tune to a particular wavelength may be figured out by the time-honored formula:

$$\text{Wavelength} = 1.884 \sqrt{L\,C}$$

where L is the inductance in microhenries and C is the capacity in microfarads.

This is rather a laborious calculation to make each time, however, and the same result may be obtained by the use of the accompanying charts. One of these charts covers the wavelengths used for broadcasting, and the other covers the lower wavelengths. Curves are given for all of the variable condenser capacities in common use.





As an example of the use of these charts, let us find the inductance which will be needed to tune to 550 meters when used with a variable condenser whose maximum capacity is 350 micro-microfarads (or .00035 mfd.). We follow along the 350 mmfd. curve until it intersects the vertical line representing 550 meters, then across to the left, and find that we need an inductance of 245 microhenries, which may be expressed also as 0.245 millihenries.

These charts may also be used in the other direction—that is, to find out what capacity will be needed to tune to a given wavelength, using an inductance of known value.

For example, if we have an inductance of 20 millihenries, for short-wave work, and wish to cover the 80-meter amateur radio band. By referring to the smaller, short-wave chart, we find that a 50 mmfd. condenser with this inductance will tune up only to 60 meters, but with a 100 mmfd. condenser it will be possible to reach approximately 90 meters. The 100 mmfd. condenser, then, is the one which must be used. It must be borne in mind, of course, that these charts give only approximate values, and they should be checked by calculation or experiment for accurate work. They will be found, however, to give very close and useful first approximations.

RADIO NEWS INFORMATION SHEETS

By Elmore B. Lyford

Output Transformers

Index No. R-342.7

AN output transformer or some similar coupling device should be used between the plate circuit of the last audio tube and the loud speaker, in every case where the tube plate voltage is over 135, or where a dynamic speaker is used. When so used, the output device serves five distinct purposes:

1. Keeps the direct (plate) current out of the loud speaker windings, preventing possible burn-out if the current is large.

2. Prevents polarization, or magnetic saturation, of the loud speaker magnets, thus improving quality.

3. Adjusts impedance differences between tube output and speaker input circuits, improving quality and increasing volume.

4. Prevents undue loss of plate supply voltage.

5. Keeps loud speaker terminals at low potential, preventing accidental shock or burn.

TRADE NAME	TYPE	FOR USE WITH	SPEAKER	TURN RATIO
FERRANTI	OP-1	171 OR 210	MAG.	1/1
	OP-2	171 OR 210	DYN.	25/1
	OP-5	112 OR 171	MAG.	1/1
	OP-8c	171 OR 210 OR 250 P.P.	MAG.	1.4/1
	OP-4c	171 OR 210 OR 250 P.P.	DYN.	25/1
	OP-7c	171 OR 210 P.P.	MAG.	1.4/1
SANGAMO	DX-210	112 OR 210 P.P.	MAG.	4/1
	GX-210	112 OR 210 P.P.	DYN.	2000/1
	CX-171	171 OR 250 P.P.	MAG.	2/1
	HX-171	171 OR 250 P.P.	DYN.	1000/1
AMERTRAN	152	112 OR 210 P.P.	MAG.	4/1
	200	112 OR 210 P.P.	DYN.	2000/1
	271	171 OR 250 P.P.	MAG.	2/1
	362	171 OR 250 P.P.	DYN.	530/1
THORDARSON	R-76	171 SINGLE	MAG.	------
	T-2876	210 SINGLE	MAG.	------
	T-2901	250 SINGLE	MAG.	------
	T-2909	250 SINGLE	DYN.	------
	T-2629	210 P.P.	DYN.	------
	T-2880	250 P.P.	MAG.	------
	T-2903	250 P.P.	DYN.	------
SILVER-MARSHALL	221	171 OR 210	MAG.	1.89/1
	* 231	----------	MAG.	3.78/1
	* 229	----------	DYN.	------
	* 248	----------	MAG.	------

* TAPPED FOR ALL POWER TUBES

TUBE	PLATE IMPEDANCE
-12A	5000 OHMS
-71A	2100 OHMS
-10	5000 OHMS
-50	1800 OHMS

Even when a magnetic type speaker is used and the plate voltage is not high, a correctly designed output transformer will serve to balance the impedances of the tube and speaker circuits more closely, and will be found advantageous.

Only two types of output transformer primary windings are necessary to match the plate impedances of the most common output tubes, as may be seen from the accompanying table.

Since the impedances are similar, one type primary winding will serve for either the UX112A or UX210, and another type for either the UX171A or UX250.

Two varieties of each type are necessary—one for a single tube output and one for push-pull output. On the secondary side, each of the above four types must be made in a type to feed a high-impedance magnetic type speaker and in a type to feed a low-impedance dynamic speaker. A complete line, then, consists of eight types of transformers, each designed for a specific use.

The accompanying tables give the type numbers of the transformers of several manufacturers, and the use for which they are intended; also the plate impedance of some output tubes.

RADIO NEWS INFORMATION SHEETS

By Elmore B. Lyford

Electrical Filters—Part 1

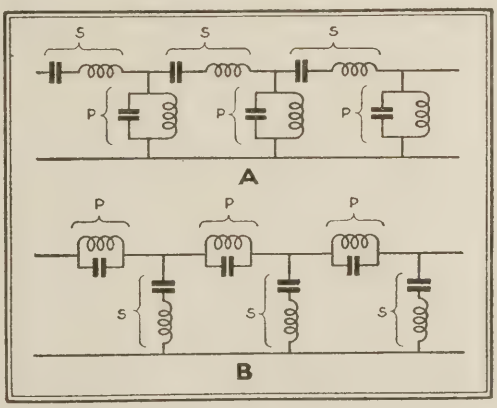
Index No. R-386

FILTERS of all types are used to separate something we want from something which we do not want, and electrical filters are no exception. Where a mechanical filter may be used to separate rocks from sand, so an electrical filter may be used to separate currents we wish to use from other currents which we do not.

The most elementary electrical filters are, of course, the simple condenser and the simple inductance. Neglecting the effect of impedance, a condenser will allow alternating currents to pass but will stop any direct current flow. Similarly, an inductance or "choke coil" will allow a direct current to flow but will impede an alternating current. The choke-coil-and-condenser output arrangement of our loud speaker "filters" is a good illlustration of both of these actions.

However, when it is a question of separating one alternating current from another, differing from it only in frequency, the filter becomes more complicated. Here we must resort to tuned circuit filters, the general cases of which are illustrated in the diagrams.

Such filters as these may be arranged to stop one frequency or band of frequencies and let all others pass, or they may be arranged to let a single frequency or band pass and stop all others. This depends entirely upon the values chosen for the inductances and capacities, and formulæ will be given in later Information Sheets.

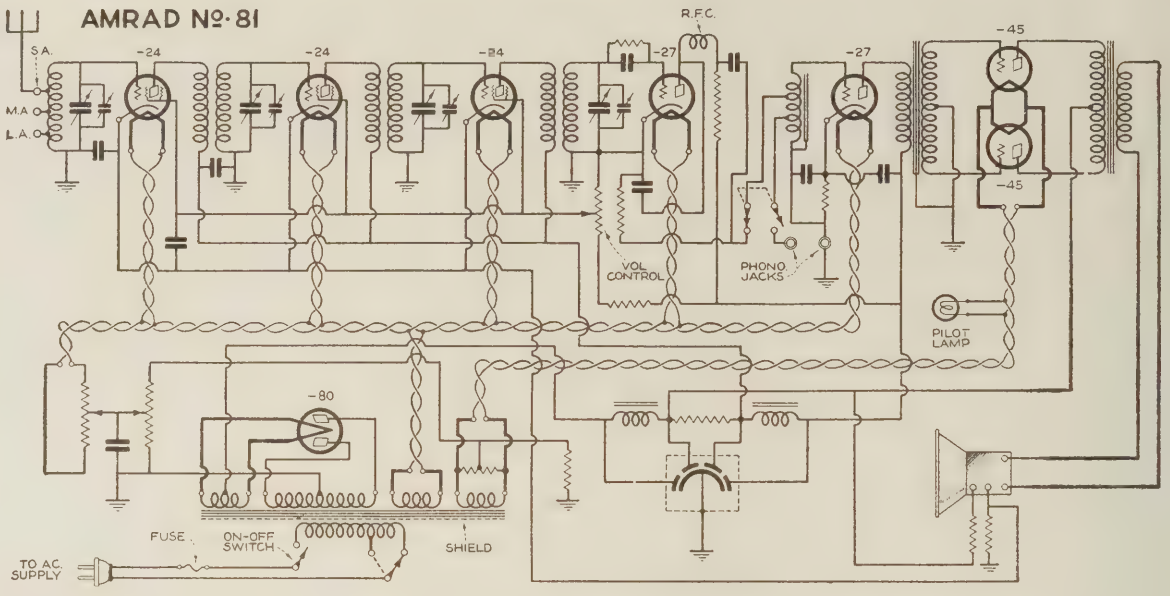


A little study of the diagrams will show how these filters work. A series resonant circuit allows one particular frequency to flow through it more easily than any other, while a parallel resonant circuit impedes one frequency only and allows all others to flow.

In diagram A, the series resonant circuits S allow one frequency only to flow through them unimpeded, while at the same time this is the only frequency not short-circuited out by the parallel resonant circuits P. This, then, is a filter which passes one frequency only, rejecting all others.

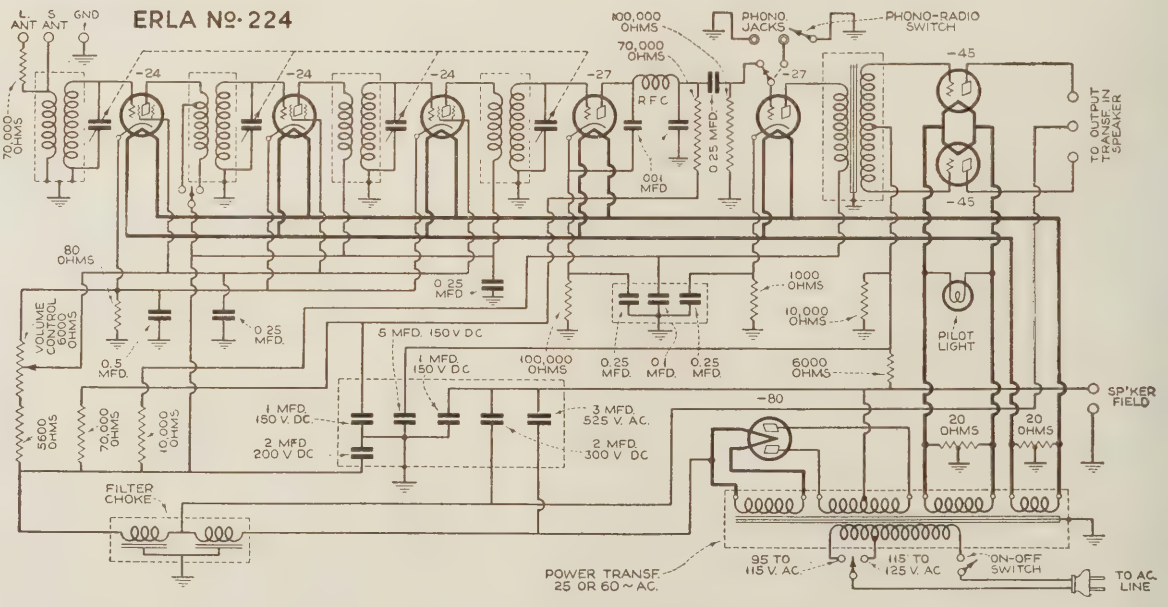
In diagram B, the parallel resonant circuits P impede one particular frequency more than any other—and what does get through is "shorted out" by the series resonant circuits S, as is no other frequency. This, then, is a filter which rejects one frequency only, passing all currents which are of any other frequency.

Radio News Manufactured Receiver Circuits



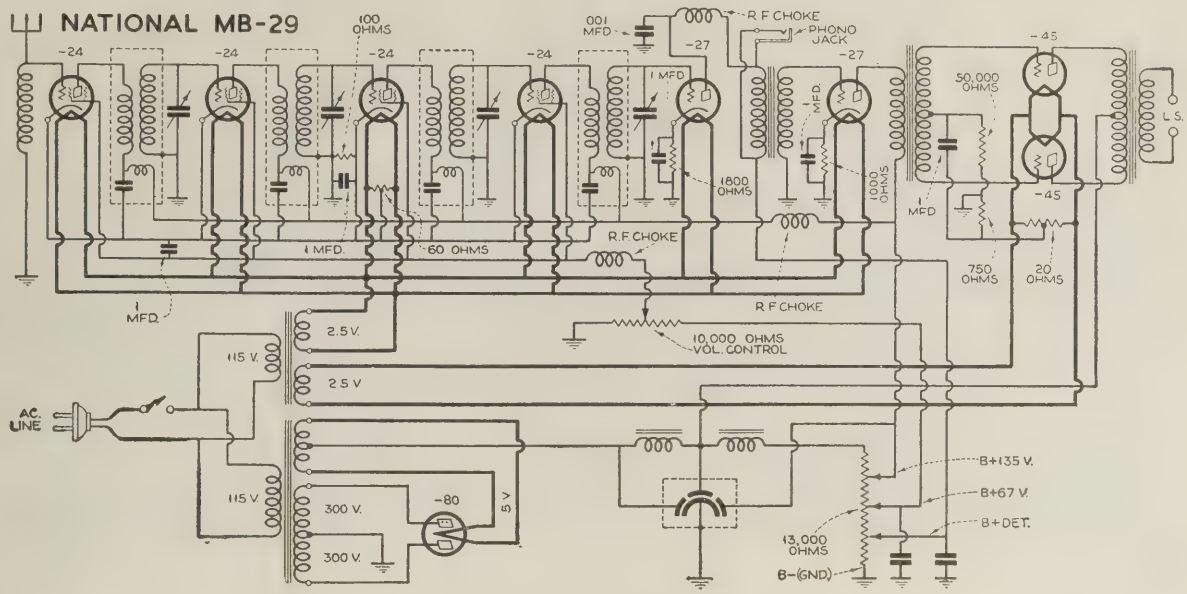
THE Amrad No. 81 receiver is designed to use three screen-grid type –24 tubes in a special radio-frequency amplifier. A grid-leak-condenser detector follows the radio-frequency amplifier. Here a –27 indirect heater type tube is used. A similar tube is employed in the first impedance-coupled audio amplifier, while two –45 power tubes are used in the output transformer-coupled push-pull audio stage. A tapped impedance in the grid circuit of the first audio tube and a phono-jack permits the playing of phonograph records, electrically. A –80 full-wave rectifier tube with its associated power transformer, filter chokes, and Mershon condensers supply the "B" potentials to the receiver, as well as field current for the dynamic speaker. The volume control varies the screen-grid potential.

Radio News Manufactured Receiver Circuits



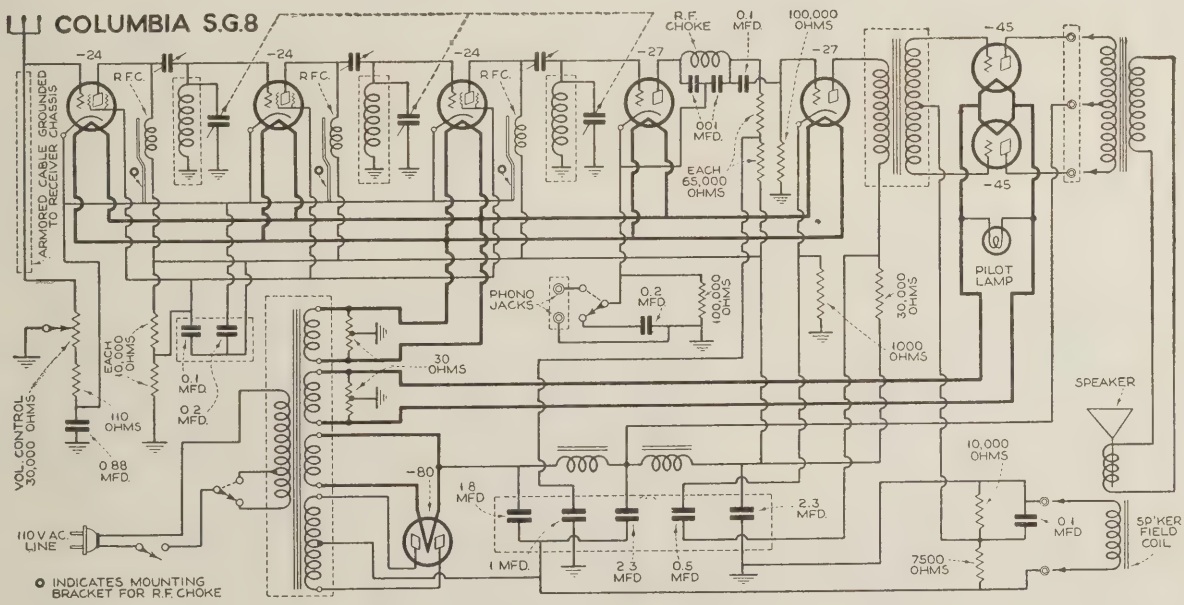
THE circuit in this receiver employs three stages of tuned radio-frequency amplification, a plate rectification type of detector making four tuned circuits. Three type –24 screen-grid tubes are required for the r.f. amplifier and a –27 tube as a detector. In the first audio-frequency stage a –27 type tube is employed with resistance coupling, followed by two –45 tubes arranged in push-pull. The very complete shielding of the r.f. transformers, tubes and variable condensers, and the use of by-pass condensers in the radio-frequency circuit, eliminates any tendency towards unstable operation. The power supply in this receiver is tapped, permitting its use on line voltages varying between 95 and 125 volts. A –80 full-wave rectifier tube and conventional filter completes the power supply.

Radio News Manufactured Receiver Circuits



IN the circuit above, the National M. B. 29, four a.c. screen-grid tubes are employed, one as untuned and three as tuned radio-frequency amplifiers, followed by a tuned detector (–27 indirect heater type). A four-ganged tuning condenser is used, permitting single dial control. The audio amplifier and power supply, a separate unit, consists of a first stage employing a –27 tube and an output push-pull stage using two –45 tubes. The power supply requires a –80 full-wave rectifier tube to supply the plate potentials for the receiver and audio amplifier. The "B" filter unit consists of conventional 30-henry choke coils and a three-section electrolytic condenser. Stabilization is provided by thorough shielding of the r.f. transformers and by-pass by r.f. chokes and condensers. Provision has been made for a phono pick-up connection in the primary of the first audio transformer.

Radio News Manufactured Receiver Circuits



THE Columbia screen-grid 8 employs a total of 8 tubes, distributed in three stages of radio-frequency amplification, detector, two stages of audio-frequency amplification and the power supply.

Three of the –24 type tubes are used in the tuned radio-frequency system of impedance-coupled amplification, which is used in this circuit in place of the customary transformer coupling. The detector employs plate rectification, enabling this unit of the receiver to handle the immensely amplified r.f. signals without overloading.

The output of the detector is resistance coupled to the first audio-frequency stage, which is followed by a conventional push-pull stage. The power supply employs the standard filter and voltage divider system. Provision has been made also for supplying the potential necessary for the excitation of the dynamic field coil.

Municipal Auditorium at Atlantic City, N. J. Scene of the 6th Annual Convention and 4th Annual Trade Show of the Radio Manufacturers' Association

Bringing the Trade-Show to RADIO NEWS Readers

BY the time this issue of RADIO NEWS reaches its readers the Sixth Annual Convention and Fourth Annual Trade Show of the Radio Manufacturers' Association will have been held and terminated at the Municipal Auditorium, Atlantic City, New Jersey.

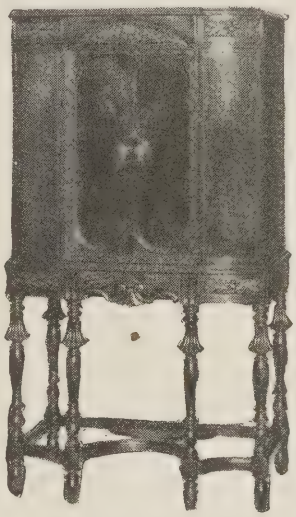
At this Convention and Show radio manufacturers displayed and demonstrated the new radio receivers, and other associated apparatus which they have designed for the coming season and which will be presented for the public's approval at the coming Radio World's Fair to be held at Madison Square Garden from September 22nd to 27th, 1930.

In order to acquaint its readers with the progress made in radio and to illustrate the new trends which are reflected in the design of tuners, loud speakers, tubes, audio channels, cabinets, speech amplifier equipment, test apparatus and other similar devices, RADIO NEWS has, with the cooperation of manufacturers of radio equipment, prepared the pages which follow, illustrating the new gadgets which will have been displayed at the Trade Show. In preparing the illustrations and data appearing on the following pages it has been possible only to identify those pieces of apparatus illustrated by means of the type or model number and the name of the manufacturer. If further information about any pieces of apparatus illustrated is desired, an inquiry, together with a stamped self-addressed envelope, should be addressed to the Radio Show Editor, RADIO NEWS, 381 Fourth Avenue, New York City. (Photographs of displayed products follow.)

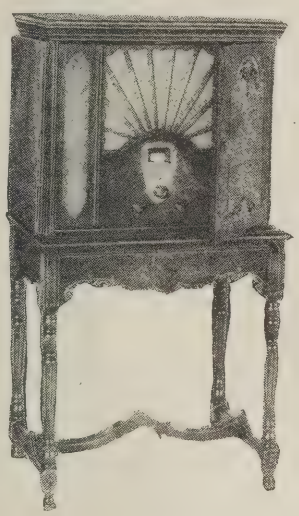
Special RADIO TRADE-SHOW Section

F. A. D. Andrea, Inc.
Model 41

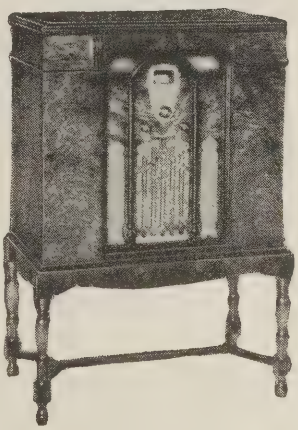
F. A. D. Andrea, Inc.
Model 42



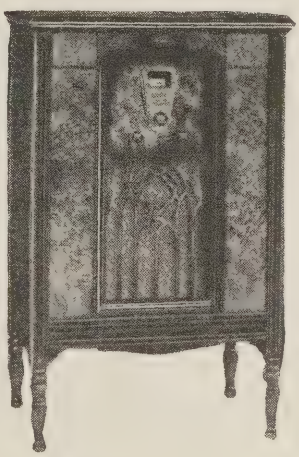
F. A. D. Andrea, Inc.
Model 46



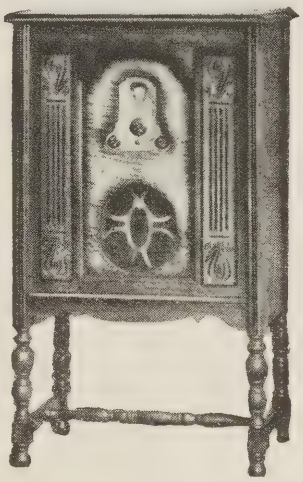
Howard Radio Co.
"The Puritan"



Howard Radio Co.
"Consolette"

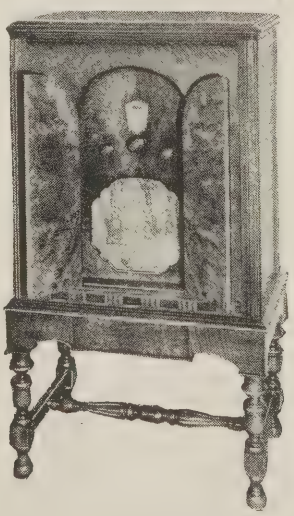


Howard Radio Co.
"Plymouth"

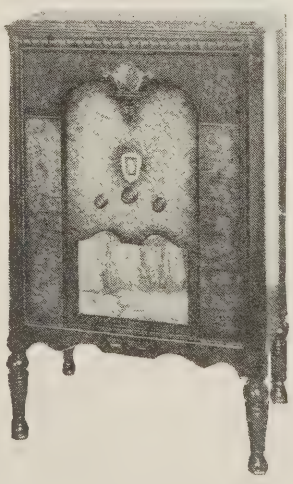


Stewart-Warner Corp.
Model 31

All American Mohawk Corp.
Model 11

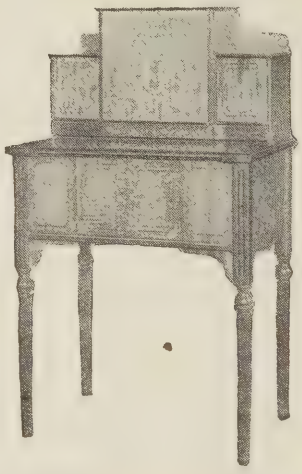


All American Mohawk Corp.
Model 29



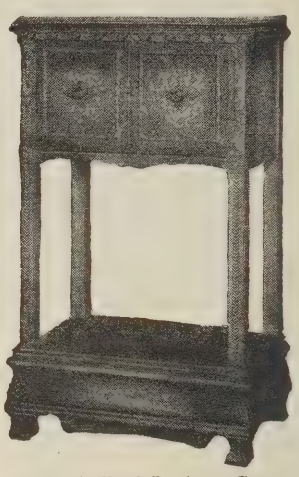
All American Mohawk Corp.
Model 39

Special RADIO TRADE-SHOW Section

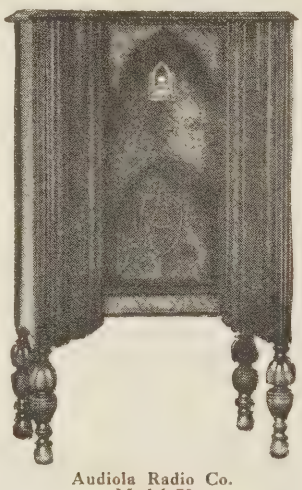


Federal Wood Products Corp.
Writing Desk

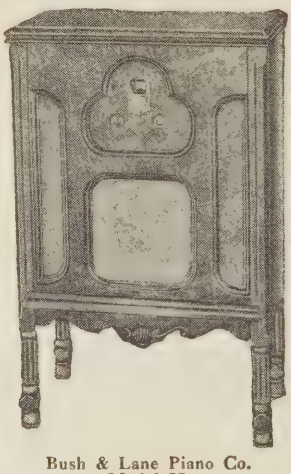
Bush & Lane Piano Co.
Model 75



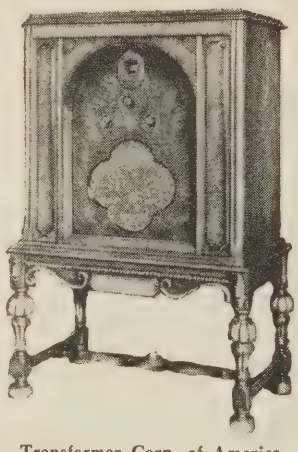
Federal Wood Products Corp.
Radio Desk



Audiola Radio Co.
Model 70



Bush & Lane Piano Co.
Model 55

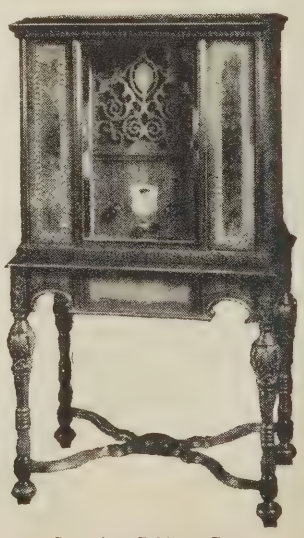


Transformer Corp. of America
Model AC-53

Audiola Radio Co.
Model 80

Superior Cabinet Corp.
Model 730

Superior Cabinet Corp.
Model 630



Superior Cabinet Corp.
Model 530

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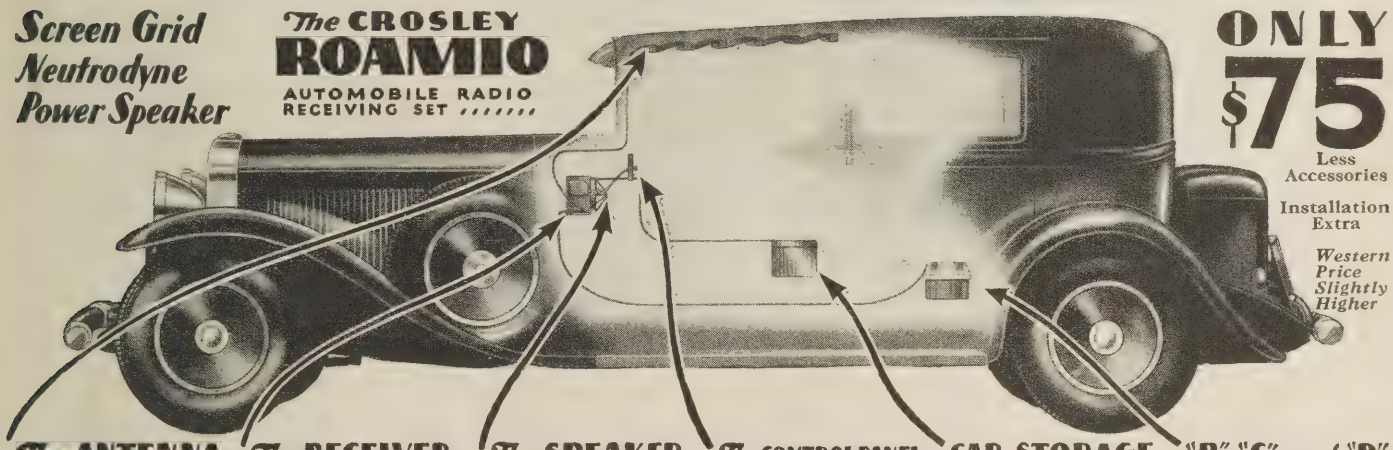
The CROSLEY ROAMIO
AUTOMOBILE RADIO RECEIVING SET

ONLY $75
Less Accessories
Installation Extra
Western Price Slightly Higher



The ANTENNA

"Was surprised at how quickly and easily the ROAMIO was installed in my car."

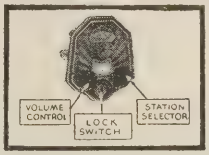
The RECEIVER

"Driving through town could easily tune out powerful local stations and get DX."

The SPEAKER

"First evening we received 30 stations with good volume, selectivity and tone."

The CONTROL PANEL

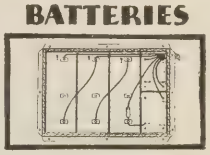


"There is no noticeable variation in signal strength in any part of the city."

CAR STORAGE (A) BATTERY

"The ROAMIO performs as well at higher speeds as when the car is driven slowly."

"B" "C" and "D" BATTERIES



"It works perfectly; gives exceptional volume with wonderful tone qualities."

Take your favorite radio entertainment with you wherever and whenever you drive with a ROAMIO

Think of the untold hours of pleasure, diversion, entertainment and amusement you derive from a radio receiving set in your home. Imagine how lost you would feel without it! Every time you fail to hear one of your favorite radio features you feel a sense of personal disappointment. Oftentimes this is due to some necessary trip in your automobile which keeps you away from home at a particular hour.

Now radio has been put on wheels—you can take your favorite radio entertainment with you wherever and whenever you drive your car. No longer need you remain at home to hear a particular program if your car is equipped with a CROSLEY ROAMIO Automobile Radio receiving set, as are thousands of cars in daily use everywhere. Men who drive to their homes after a busy day in office, factory or store find diversion and relief from business cares and arrive home in a pleasant and happy frame of mind. Women who drive children to and from school find amusement and entertainment for themselves and children. Salesmen who travel by automobile find a friendly relief from the monotony of driving. No matter where you are—driving in the city, touring in the country, parked awaiting family or friends—the CROSLEY ROAMIO will bring you your choice of radio broadcasts exactly the same as would the receiving set in your home were you comfortably seated at your fireside.

The CROSLEY ROAMIO is extremely selective and sensitive and has extraordinary distance-getting ability. The automatic volume control maintains a practically uniform volume even on distant stations. It also maintains the volume in shielded areas, and eliminates the necessity of constantly changing the volume. The special lock in the control panel makes it impossible to operate the set when it has been locked by the owner. Uses five tubes, two of which are Screen Grid.

The CROSLEY ROAMIO is easily and quickly installed in practically any automobile. It fits snugly and conveniently under the dash, entirely out of the way yet in a position to render full volume for the entertainment of all in the car. The control panel is attached to the dash, handy to the finger tips. The set is moisture and dust-proof. It is enclosed in a metal case, one side of which is conveniently removable when necessary. The installation of a CROSLEY ROAMIO in your car can be made quickly and conveniently, whether or not the car has an in-built antenna. The cost is little. The entertainment and delight it provides for your family and friends are great.

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Powel Crosley, Jr., *President*
CINCINNATI, OHIO
Home of WLW—*"the Nation's Station"*

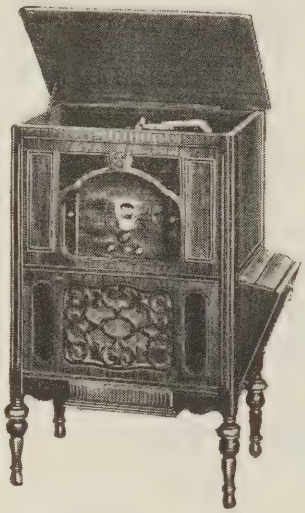
The CROSLEY ROAMIO is recommended for use in motor boats and cruisers.

YOU'RE *THERE* WITH A CROSLEY

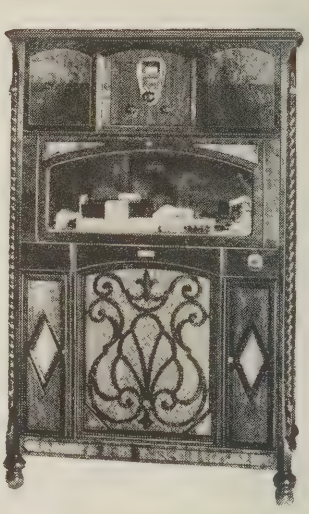
CROSLEY RADIO

Special RADIO TRADE-SHOW Section

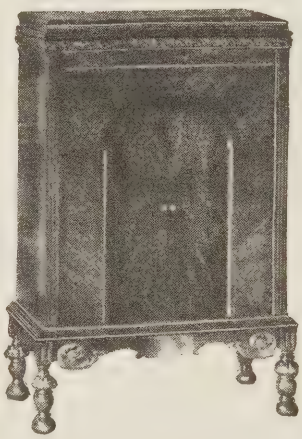
The Platter Cabinet Co.
Nickel in Slot Machine



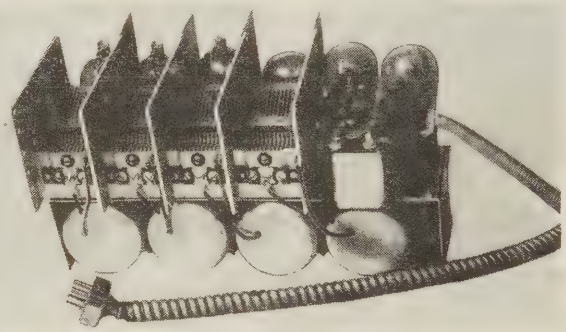
Excello Products Corp.
Model R71—Phono-Radio Console



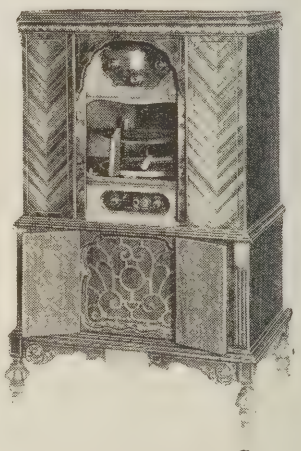
The Capehart Corp.
Model 110



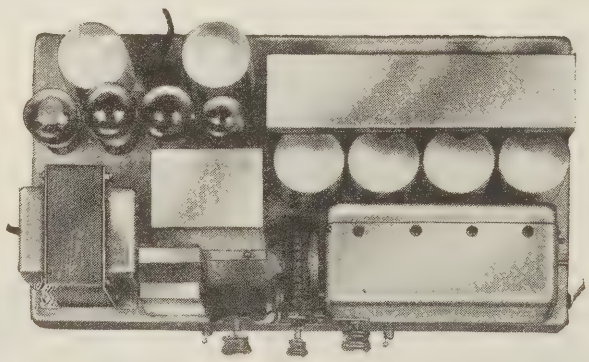
Radio Master Corp.
Model 218—Phono-Radio Combination



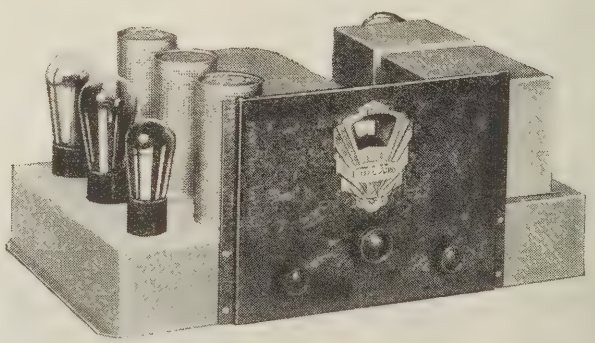
Automatic Radio Mfg. Co., Inc.
6-tube Automobile Receiver



Deca Disc Phonograph Co.
"Creatone" Model 99K



Wells-Gardner & Co.
Model 80—Private Label Chassis



Pierce-Airo, Inc.
1931 Chassis

JENKINS
FIRST IN TELEVISION

All products bearing this trademark represent recognized leadership and advancement in the new science of television.

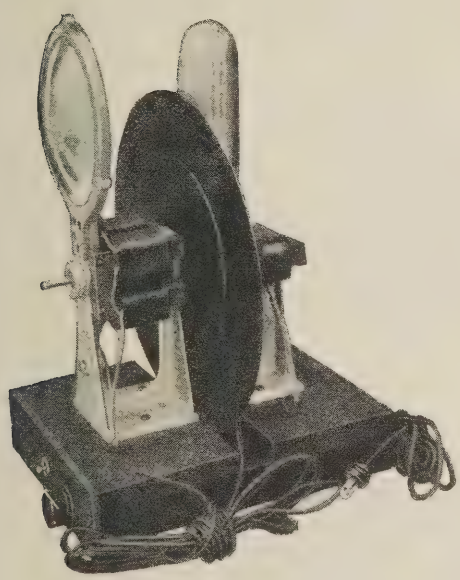
The Jenkins Television Corporation
Pioneer of Television

ANNOUNCES a special television receiver covering the television broadcast band (100-150 meters) with wide frequency response to receive good pictures.

A large Radiovisor, Model 200, completely assembled and ready to operate—

A small Radiovisor, Model 100, assembled and ready to operate and —

A knock-down Radiovisor-Kit No. 1 for the home constructor. Price range of models from $42.50 to $570.00. ¶ These products can now be supplied to distributors and dealers who see the virgin opportunity open to pioneers in this field. The same thrills and enthusiasm which marked the early sound broadcast reception are intensified in this new science of receiving talking pictures by radio.



RADIOVISORS

FOR the first time Jenkins makes available commercial apparatus for television reception, produced and developed under the patents of C. Francis Jenkins, the "Father of Television." Ingenious in design, sturdy in construction, reliable in operation. In a word, the Jenkins television apparatus is the development of the newest and most practical ideas in home television.

NIGHTLY PROGRAMS

Radiovision programs regularly transmitted by Jenkins Station W2XCR, Jersey City, N. J., and W3XK, Washington, D. C., and others. Bigger, better, more entertaining programs are coming!

DEALERS and JOBBERS

Ask us about the Jenkins proposition to the trade. Television is progressing fast—get in touch with us *now*.

SETS READY NOW

Jenkins Radiovisors, Models 100 and 200, and the Radiovisor-Kit No. 1, are now ready for shipment. Write for literature or, better still, order a sample Radiovisor. Use the coupon.

MAIL THIS COUPON

Jenkins Television Corporation
346-370 Claremont Avenue, Jersey City, N. J.

Please send me the following at the usual trade discounts.

- ☐ Jenkins Radiovisors Model 100.
- ☐ Jenkins Radiovisors Model 200.
- ☐ Radiovisor-Kit No. 1.

Name_____

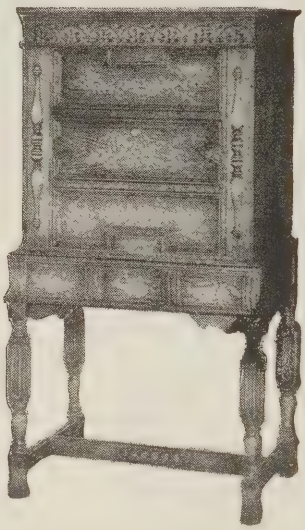
Address_____

City_____ State_____

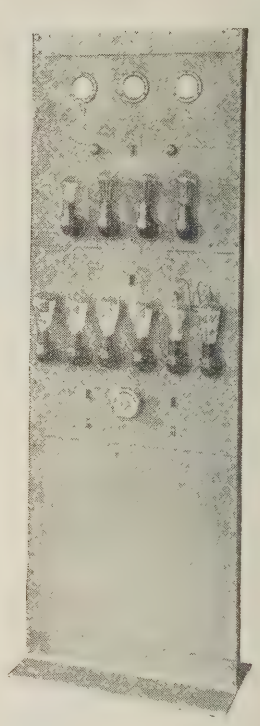
JENKINS TELEVISION CORPORATION · 346-370 Claremont Avenue, Jersey City, N. J.

Special RADIO TRADE-SHOW Section

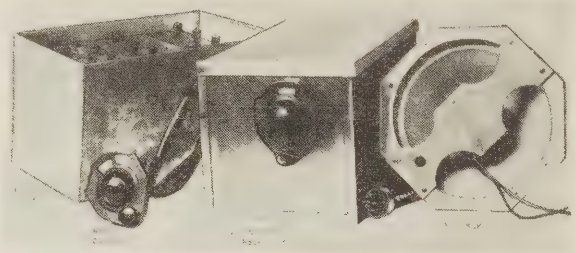
Operadio Co.
Rock Amplifier



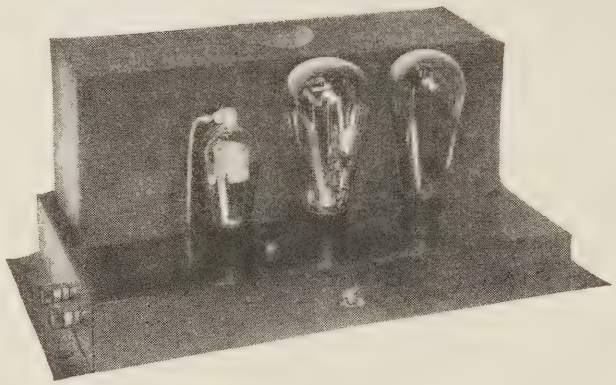
Federal Wood Products Corp.
Phono-Radio Combination



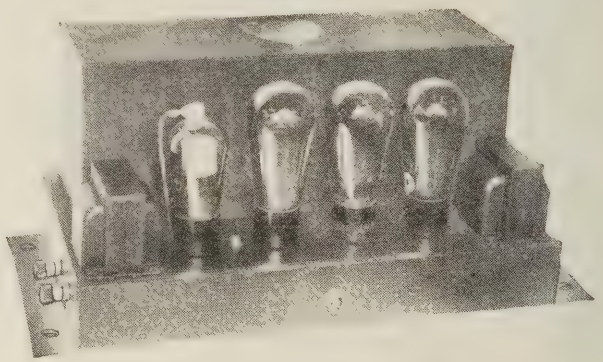
Webster Electric Co.
Model PA-11
(Rack and Panel Amplifier)



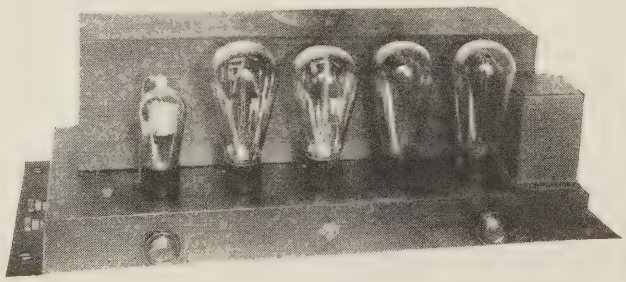
Automatic Radio Mfg. Co., Inc.
Automobile, Plane and Motorboat Receiver



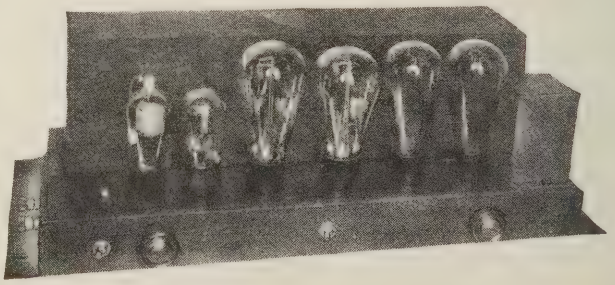
Amplex Instrument Laboratories
Loftin-White Direct Coupled Audio Amplifier—LW-50-B



Amplex Instrument Laboratories
Loftin-White Direct Coupled Audio Amplifier—LWB-M



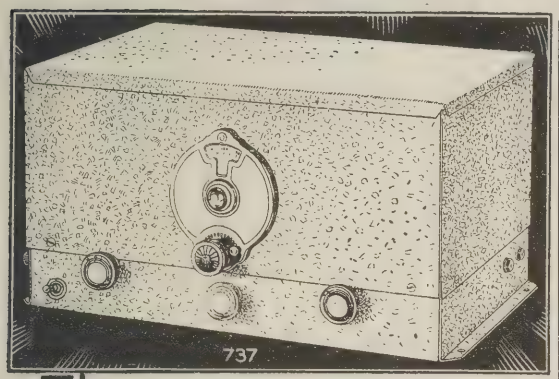
Amplex Instrument Laboratories
Loftin-White Direct Coupled Audio Amplifier—LW-50-B



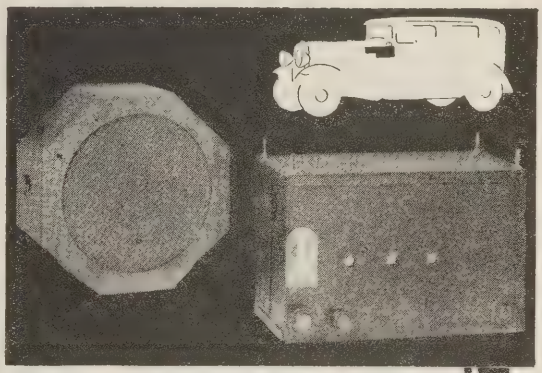
Amplex Instrument Laboratories
Loftin-White Direct Coupled Audio Amplifier—LW-350-B

SM

For a Sure-Fire Vacation: a Car, the Right Companion, and an S-M "*Playfellow*"



The S-M 770 Playfellow will be extensively advertised throughout the summer. Installation of this receiver together with speaker and necessary "B" batteries will be a veritable gold mine to radio technicians everywhere. Send the coupon at once.



A Short-Wave *Wow!*

There is no longer any reason for not having a short-wave set comparable to a broadcast receiver.

The new S-M 737 Bearcat has *everything*—perfect battleship shielding, two double-shielded tuned circuits, a regenerative non-radiating detector, a powerful '45 second audio stage, *built-in* power supply, *one dial* tuning, a *real* gang condenser and a screen-grid circuit with *two screen-grid tubes!*

And that isn't all—not by a long shot. You can spread the crowded ham bands on the Bearcat without tearing the set apart! A little midget condenser that's built right in does the job, and a twist of the wrist controls it.

Tubes required: 2—'24, 1—'27, 1—'45, 1—'80.

Complete with built-in power supply, wired, in cabinet as illustrated, $139.60 *list:* subject to usual trade discount.

There is no doubt about it—you'll want an auto receiver in your car before the summer is over—and you will want a *real one*—one that can "take it and like it"—one that has been tested over hundreds of miles of rough back-country runs—one that is not only built to stand the gaff but to give real console-model reception too!

You'll want it simple mechanically: when getting another station you'll want to control your tuning positively—not through a dubious, jerky, flexible shaft.

You'll want one you can rely upon when you are hundreds of miles from town—there'll be no service station at your fishing camp.

You'll want volume enough to reach up and down the beach—enough for unrestrained gaiety. Decidedly, you'll want clearness of tone—and that's the clinching reason why only the laboratory that produced the world-famous SILVER RADIO should be entrusted with the musical reproduction that will make or mar your vacation.

The Playfellow is small (12 inches long by 7½ inches wide, and 6¼ inches deep), sensitive (5 microvolts per meter), screen-grid (3 s.g. tubes including detector), and has a standard S-M 810 illuminated drum dial—a pocket edition of the finest receiver, especially designed for its job.

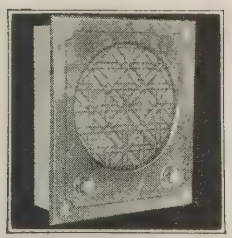
There's no cutting of cowl or instrument panel to install it. It is readily attached to the car bulkhead, under the cowl to the right of the driver's seat.

Tubes required: 3—'24, 1—'12A, 1—'71A.

Price complete, except for tubes and speaker, $79.50 list. Component parts are standard, price totaling $61.40 list.

S-M 870 Automotive-Type Magnetic Speaker (octagonal shape, 9½ inches wide and only 3 inches deep) takes the maximum output of a '71A tube. List price, complete with mounting brackets, $15.00.

771 Auto Receiver Accessories, including all necessary installation equipment except tubes and batteries; list price, $17.50.



BRAND NEW! S-M

Magnetic Speakers

Including Flush Mounting Type

The newest additions to the dominating S-M speaker line are the 871, 872 and 873 type magnetics. They are perfect designs for P. A. installation in hotels, schools, etc., where reception is distributed from a centralized amplifier. These units are of the low-impedance type, but on special order with two weeks delivery, they can be had in any impedance values desired. The 871 and 873 are built in beautiful cabinets. The 871 is finished in black and the 873 in walnut, but in quantities both can be had finished to harmonize with any interior. The 873 is a flush-mounting wall type and has a volume control and a three channel program selector mounted on the front panel. Outside dimensions of the panel are 11⅞ inches wide by 15¼ inches long. Price complete $35.00 list.

The 871 magnetic speaker is similar to the 870, but of low-impedance type. Price $16.00 list.

The 872 magnetic speaker, chassis only, 10½" cone, special oversize unit. Price $20.00 list.

SILVER-MARSHALL Inc.

6405 West 65th Street
Chicago, U. S. A.

Silver-Marshall, Inc.
6405 West 65th St., Chicago, U. S. A.

....Send your latest catalog with sample copy of the RADIOBUILDER.

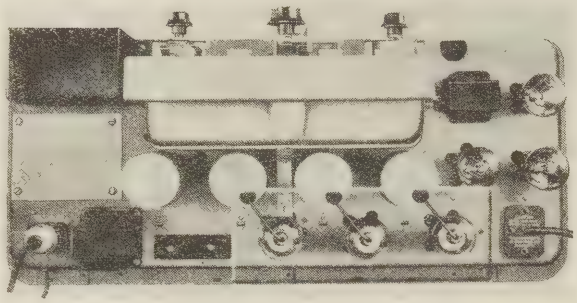
....2c enclosed; send Data Sheet No. 22 on 770 "Playfellow" and Installation.

....4c enclosed; send also Data Sheet No. 21 on the new 737 Short-Wave Bearcat.

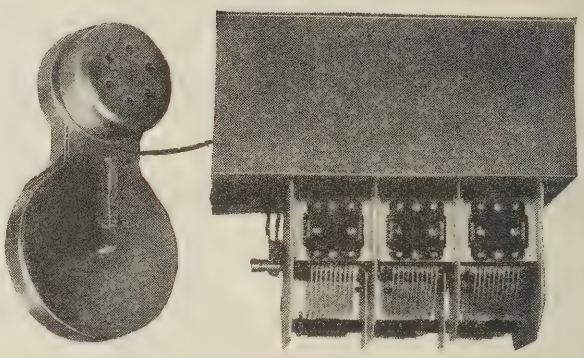
Name.....

Address.....

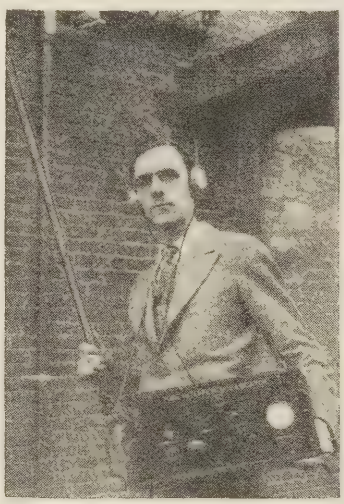
Special RADIO TRADE-SHOW Section



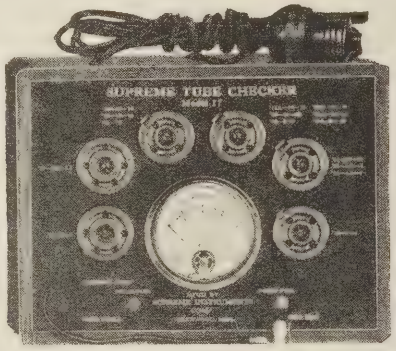
Philadelphia Storage Battery Co.
Model 40



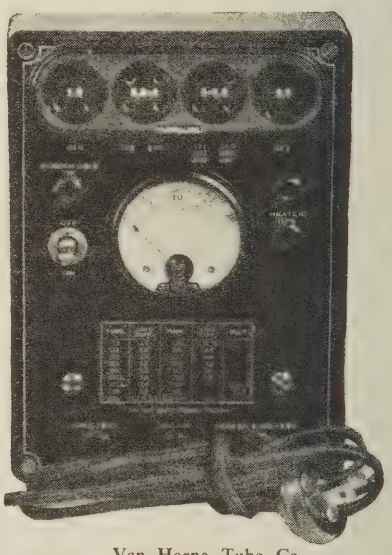
Utah Radio Products Co.
Electronic Remote Control Unit



Tobe Deutschmann Corp.
Interference Locater



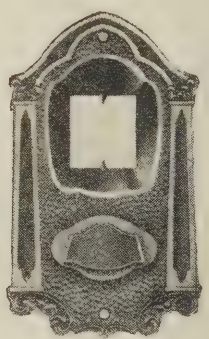
Supreme Instruments Corp.
Tube Checker Model 17



Van Horne Tube Co.
Model D Tube Checker

Amplion Corp. of America
Microphone

The Webster Co.
RP-Parallel 250



Crowe Name Plate & Mfg. Co.
Escutcheon

AMAZING NEW TUBE INVENTION REVOLUTIONIZES RECEPTION . . . EVEREADY RAYTHEON 4-PILLAR TUBES SURPASS ALL PREVIOUS STANDARDS

FOR clear reception, breath-taking in its realism, put a new Eveready Raytheon 4-Pillar Tube in each socket of your receiver. These tubes show you how truly fine your radio set can be. They are different from all others . . . in construction, and in results.

Examine an Eveready Raytheon

Look at the diagram below, showing Eveready Raytheon's revolutionary improvement in construction. See the solid, four-cornered glass stem, inside the tube, at the bottom. Notice, imbedded in it, the four sturdy pillars supporting the elements . . . twice the number and twice the rigidity of ordinary tubes! See how the elements are anchored, front and rear, top and bottom, so that they always stay in perfect relation to each other.

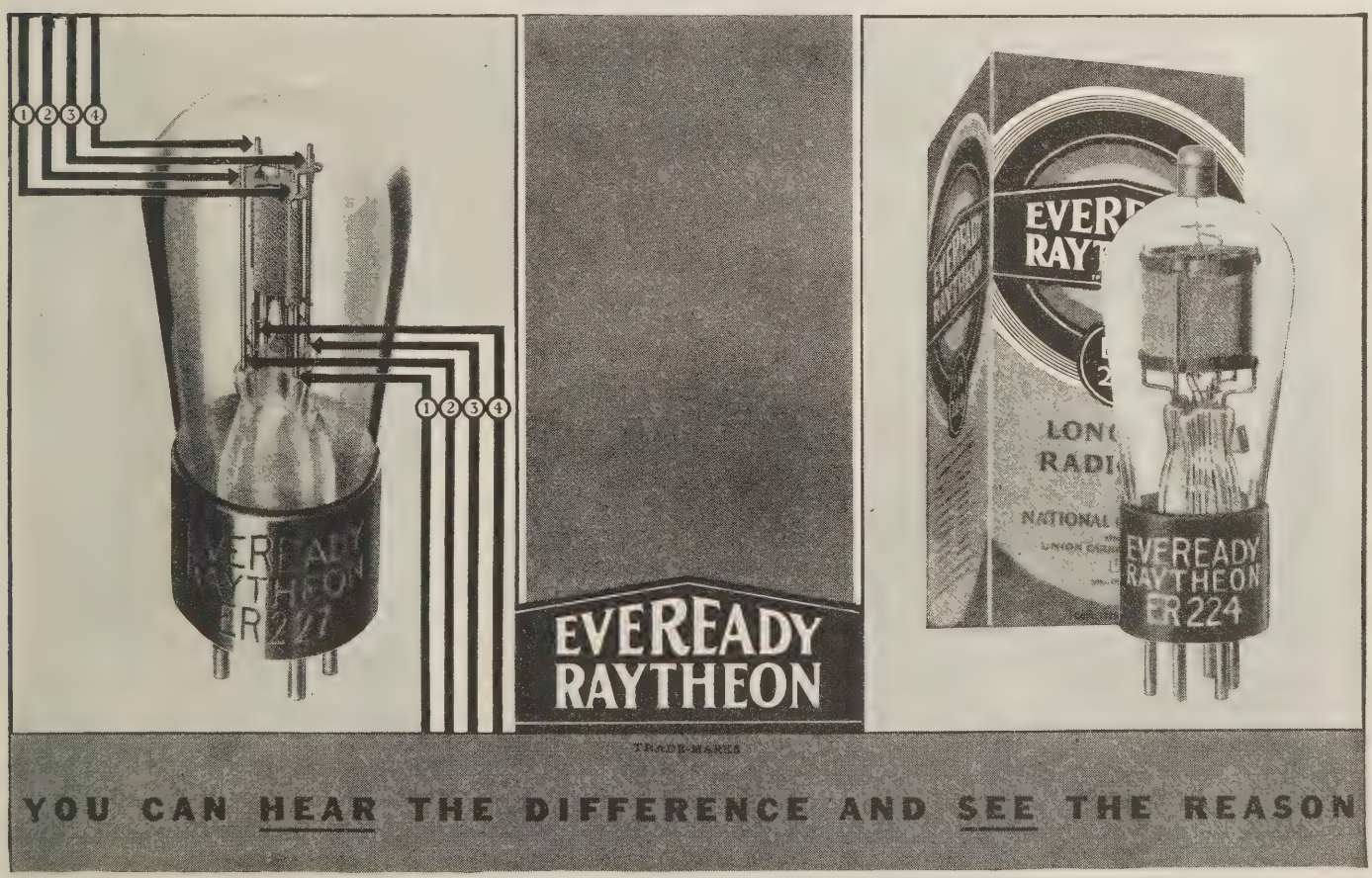
This 4-*Pillar construction* means that the Eveready Raytheon Tube elements remain in perfect alignment, despite jolts due to shipment or handling. Contrast this solid, rock-ribbed construction with the type used in ordinary tubes having only two supports, where the sensitive elements are subject to distortion — with a consequent let-down in performance. This 4-*Pillar construction* is patented and exclusive with Eveready Raytheon; no other tube is permitted to use it.

Eveready Raytheons come in all types

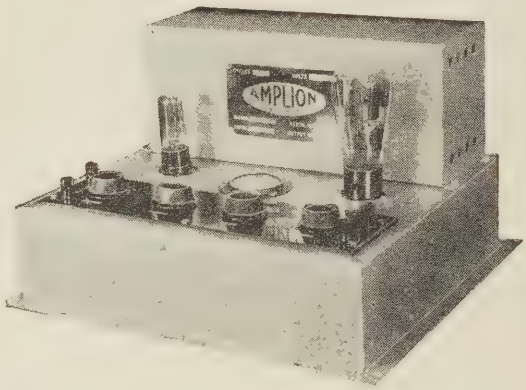
These tubes are built by the makers of the famous Eveready Layerbilt "B" Batteries — another vital radio improvement. Eveready Raytheons fit the sockets of every standard A. C. and battery-operated receiver now in use. For a new kind of reception from your present radio, call your dealer today, and ask him to renew all your tubes with Eveready Raytheons.

The Eveready Hour, radio's oldest commercial feature, is broadcast every Tuesday evening at nine (New York time) from WEAF over a nation-wide N. B. C. network of 30 stations.

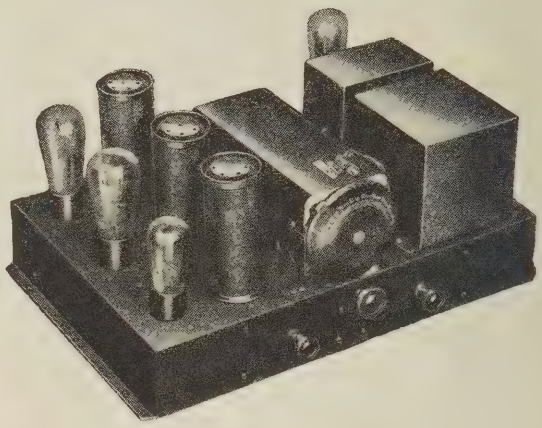
NATIONAL CARBON COMPANY, INC.
General Offices: New York, N. Y.
Branches: Chicago Kansas City New York San Francisco
Unit of Union Carbide UCC *and Carbon Corporation*



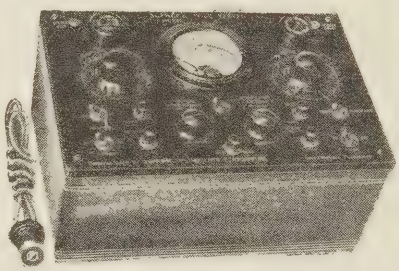
Special RADIO TRADE-SHOW Section



Amplion Corp. of America
Speech Amplifier

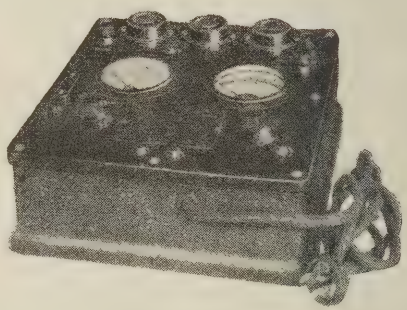


Wholesale Radio Service Co.
Broadcast Receiver

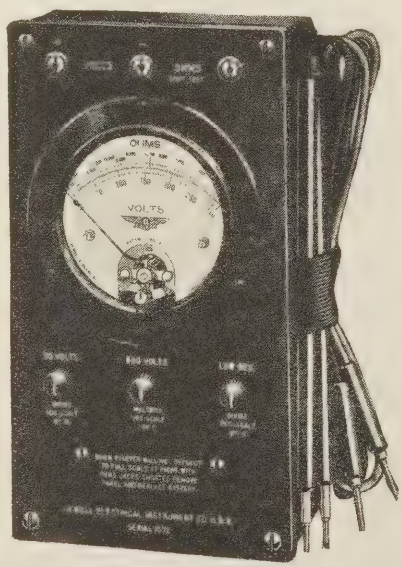


Supreme Instruments Corp.
Tube Tester Model 50

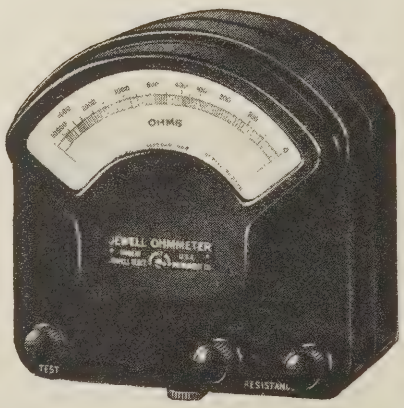
Radio Products Co.
Auto Radio Set Analyzer



Weston Elec. Instrument Corp.
Model 555 Counter Tube Checker



Jewell Electrical Instrument Co.
Direct Reading Volt Ohmmeter

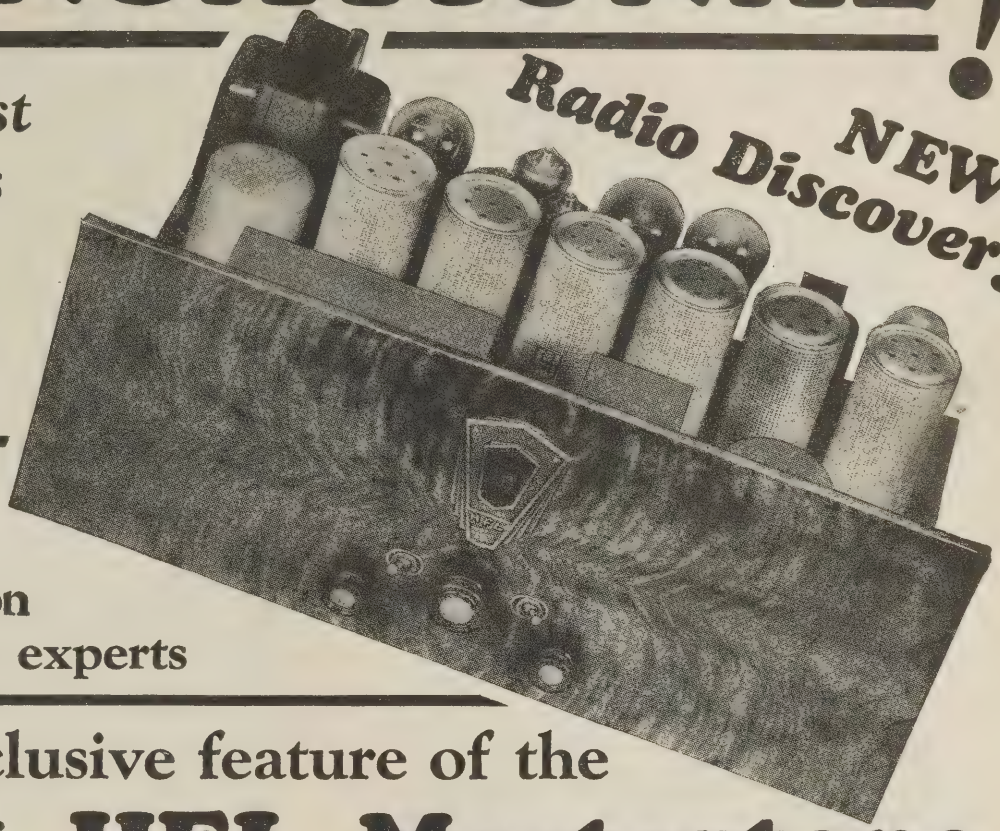


Jewell Electrical Instrument Co.
Ohmmeter

Supreme Instruments Corp.
Ohmmeter

SENSATIONAL!

- Scientist
- perfects
- long
- sought
- device



NEW Radio Discovery

- Hopkins'
- amazing
- new invention
- approved by experts

Now an exclusive feature of the

• 1931 HFL Mastertone

At last! Radio perfection is realized. After three years of intensive research work, assisted by a corps of laboratory experts, Mr. Charles L. Hopkins, noted radio scientist, has actually developed the first practical band rejecting amplifier. This miraculous new system, long the dream of radio designers, permits the construction of a remarkably efficient receiver which is ideally perfect in operation. Stations over the entire continent may now be received with an ease of tuning, unprecedented clarity of tone and total lack of interference that astonishes engineers and fans alike.

• Interfering Stations Rejected

Application of the Hopkins principle to the 1931 HFL Mastertone has immediately resulted in three outstanding improvements. Now, for the first time in radio history, it is possible to tune in an exact 10 kilocycle channel to the complete exclusion of everything else on the air. Not 9 or 11 or 16 kilocycles, but 10—with mathematical accuracy. Stations on each side of the selected band are sharply cut off and *actually rejected*. This heretofore unattainable action now takes place over the entire tuning range. The set does not "go broad" even on the highest wave lengths.

• Tonal Perfection Realized

The salient feature of the Hopkins band rejector system is that it handles all musical frequencies with an absolutely even intensity. No sacrifice in selectivity is made in order to obtain these marvelously realistic tonal reproductions. Although the 1931 HFL Mastertone maintains a precise 10 kilocycle signal channel at all times, every note and each delicate overtone *right up to 5000 cycles* comes through with a life-like quality that is a revelation. Far distant stations have the same superb tones due to the complete elimination of all local interference.

• 12,500 Mile Reception

Engineers the country over proclaim the 1931 HFL Mastertone to be the greatest long distance receiver ever designed. Its range is easily 12,500 miles (world-wide reception) whenever weather conditions permit such distances to be covered. Five 224 screen grid, two 227, two 245 and one 280 tubes are employed. A tremendous reserve power of *over 400 per cent* is available. The Mastertone is unconditionally guaranteed to receive any station on earth that can be heard with a radio set.

• Ultra Modern

In addition to the Hopkins RF amplifying system the 1931 HFL Mastertone incorporates every modern improvement known to science. One dial, one spot, 180 K.C. intermediate amplifier. Resistance coupled, push-pull phonograph amplifier, controlled from panel. Puncture proof, high voltage, humless Electrofarad filter condensers. Self contained, all steel heavily cadmium plated chassis. Doubly shielded radio frequency circuits and dozens of other entirely new features. Our FREE literature gives complete information and prices. *Send for it today!*

DEALERS: The New Mastertone is the sensation of the century. Get in on the biggest radio boom ever known. Rush this coupon attached to your business letterhead for special proposition. *ACT QUICKLY!*

HIGH FREQUENCY LABORATORIES

Dept. B, 28 North Sheldon St., Chicago, U. S. A.

HIGH FREQUENCY LABORATORIES, Dept. B
28 North Sheldon Street, Chicago, U. S. A.

Gentlemen: Please send me your FREE literature and photos of the 1931 HFL Mastertone.

☐ Check here if your name is *not* on our mailing list now.
☐ Check here if you have been receiving mail from us.

Name.....

Address.....

City..... *State*.....

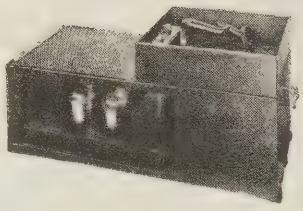
(PLEASE PRINT PLAINLY)

Send This Now!

This coupon is not an order . . . you incur no obligation

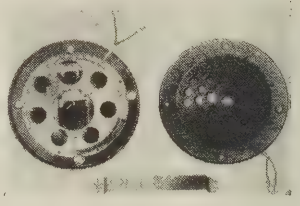
HFL

Special RADIO TRADE-SHOW Section

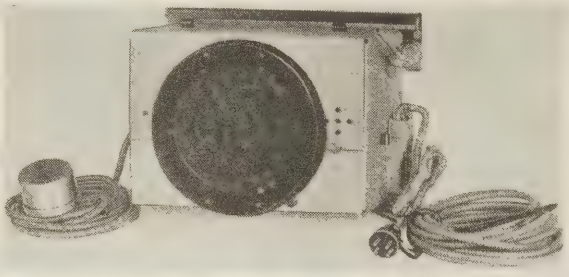


Operadio Mfg. Co.
Public Address Amplifier

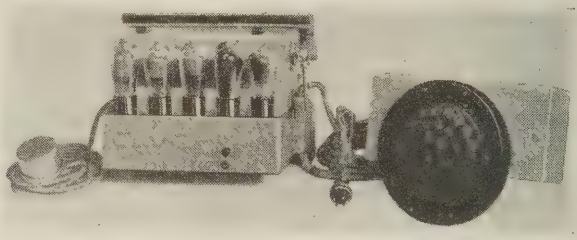
Operadio Mfg. Co.
Uni-Directional Bowl Speaker



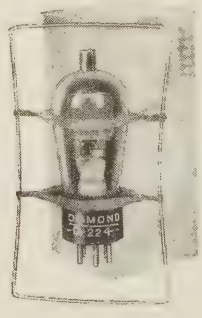
American Bosch Magneto Corp.
Loud Speaker



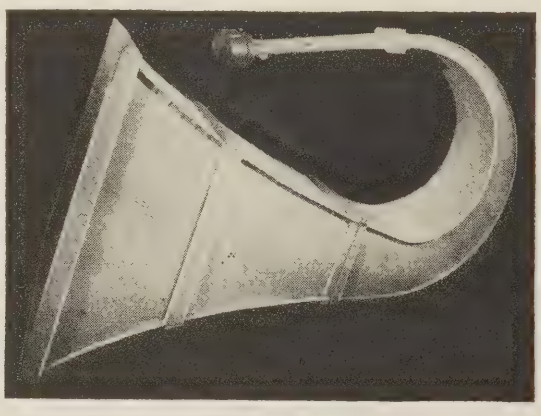
American Bosch Magneto Corp.
Auto Radio Installation



American Bosch Magneto Corp.
Same as at left with shield compartment and speaker removed to show tubes.

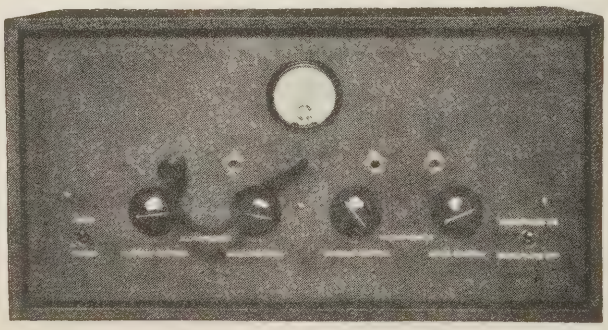


Diamond Electric Corp.
Type D-224 Tube



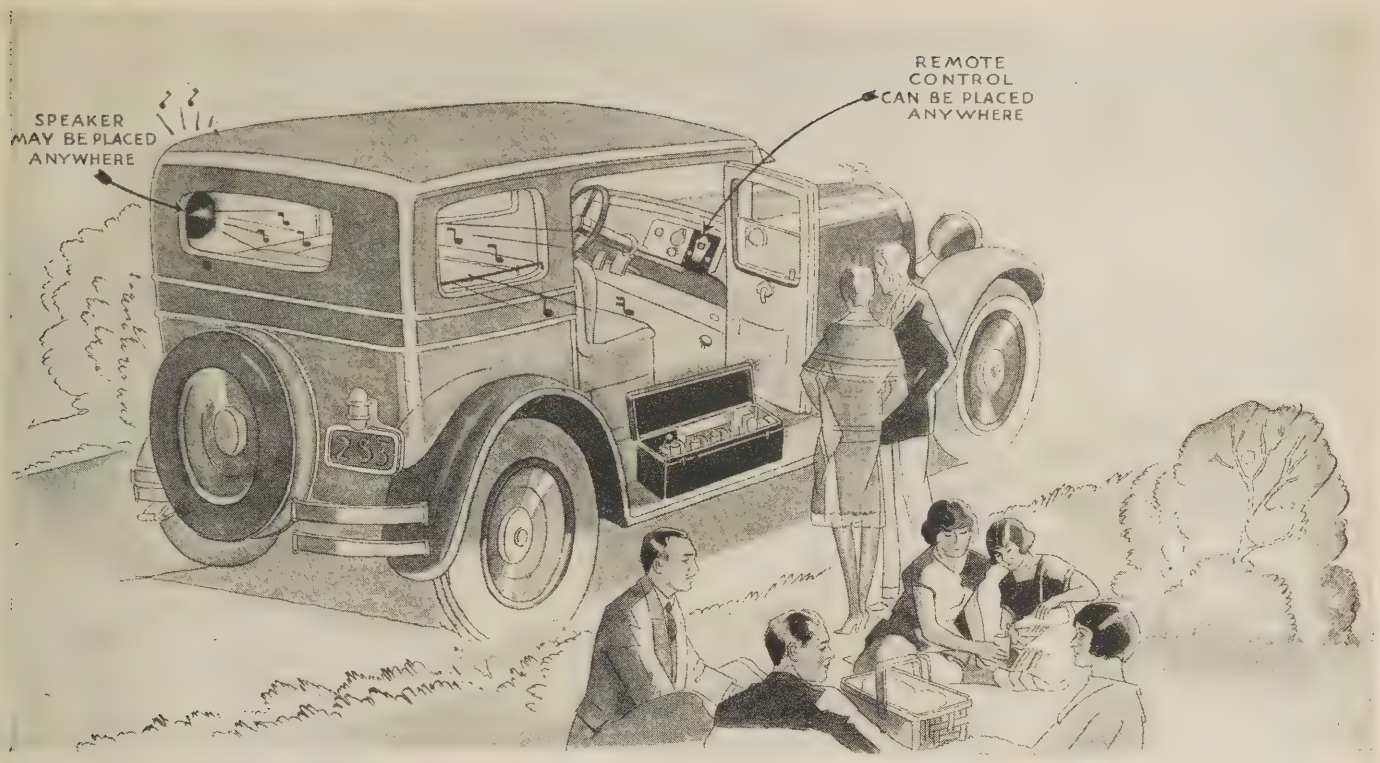
Amplion Corp. of America
Curved Exponential Type Horn Speaker

Diamond Electric Corp.
Type D-224 Screen Grid Radio Frequency Amplifier Tube



The Webster Co.
Micro-Control Box

Gates Radio & Supply Co.
Type B-93 Remote Control Amplifier



The "AUTO PILOT" goes on your running board and does not lessen the car's trade-in value when taken off to go on your next car

"Auto Pilot" Full Screen Grid Radio

LICENSED UNDER R.C.A. PATENTS

Increases Your Automobile Pleasure

Nobody will have a more up-to-date automobile than yours when you have assembled this powerful "AUTO PILOT" Screen Grid broadcast receiver kit, placed it on your running board in its attractive black japanned case and connected its remote control dial and speaker. Even the specially designed PILOT "undercar" aerial attaches between the axles without necessity for harming your car's exterior or interior.

This new and advanced "AUTO PILOT" not only has every up-to-date feature of radio to assure you distance, selectivity, tone quality and volume—but the welfare and future trade-in value of your car has also been a chief consideration of design. The New "AUTO PILOT" requires no mutilation of floor, instrument board or upholstery to make a solid installation—convenient to operate, taking up no foot or seat room.

You Can Install the "Auto Pilot" in Your Car in An Evening.

Four-224 A.C. Screen Grid Pilotrons comprising three stages of radio frequency and detector give the "Auto Pilot" tremendous pick-up and distance range. A. C. Pilotrons are operated from the car's battery instead of battery type tubes because they are rugged and non-microphonic.

Auto Pilot Kit 47.50
Complete with aerial less Pilotrons and Speaker

Thick sponge rubber mountings take up road shocks. The audio amplifier system gives enough volume for outdoor dancing, with tone quality of the highest order. Filament current drain from car's storage battery is only 4 amperes. Plate current is 20 milliamperes from three 45-volt "B" batteries.

Inquire of your local Pilot Radio Dealer or write direct to

PILOT RADIO & TUBE CORP.

323 BERRY ST., BROOKLYN, NEW YORK

Chicago Office: 234 South Wells St. *San Francisco Office:* 1278 Mission St.

FACTORIES AT LAWRENCE, MASS.

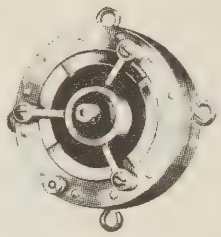
FOR DEPENDABILITY

LICENSED BY R.C.A.

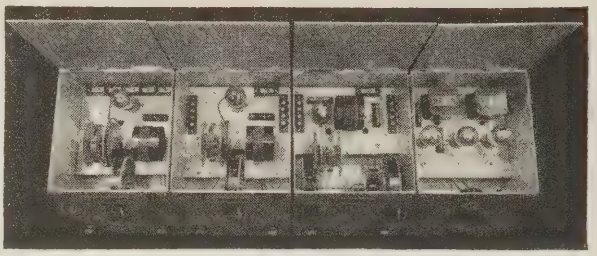
PILOTRON RADIO TUBES

Endorsed by Professionals

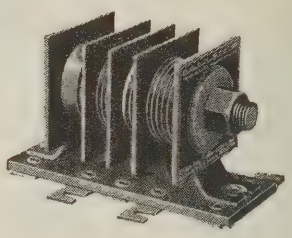
Special RADIO TRADE-SHOW Section



Ellis Electrical Laboratory
Two-Button Microphone, Models 29 and 30

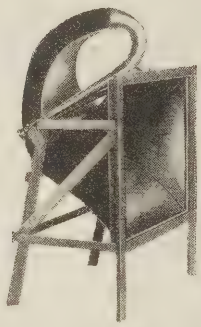


C. R. Leutz, Inc.
Short-wave Receiver



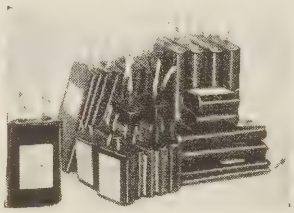
Elkon, Inc.
Rectifier

French Battery Corp.
Auto Radio "B" Battery



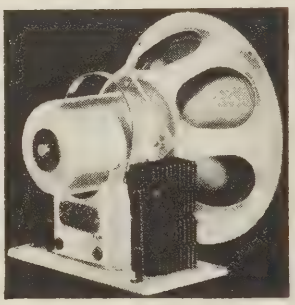
Platter Cabinet Co.
New Phototone—Talka Film

Champion Radio Works, Inc.
Champion Radio Tube, Type UY 224

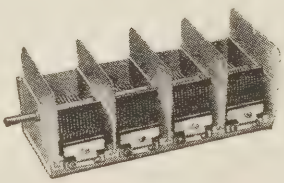


Bassett Co.
Condenser Cartridges

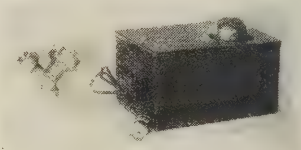
Tobe Deutschmann Corp.
Filter Units



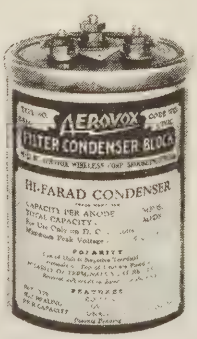
Oxford Radio Corp.
Model 71 Theatre Speaker



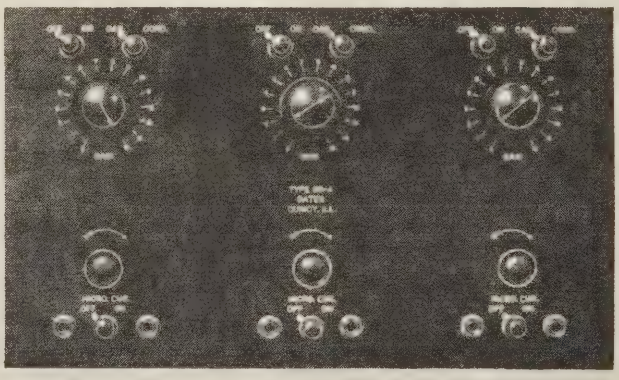
United Scientific Laboratories
Type SG Shielded Condenser



Amplion Corp. of America
"Y" Horn Coupler and Amplifier



Aerovox Wireless Corp.
Electrolytic Condenser



Gates Radio & Supply Co.
Type 98A Mixing Panel

Aerial Insulator Co.
Solar Electric Clock, Model 700

MORE PROGRAMS

ABSOLUTELY NO A. C. HUM

"CLOUGH-SYSTEM" TUNED AUDIO

FILTERED TONE CRYSTAL-CLEAR

AUTOMATIC VOLUME CONTROL

DX PERFORMANCE THAT WILL KEEP YOU UP ALL NIGHT

SCREEN-GRID POWER DETECTION

FIVE TUNED CIRCUITS 10 KC. SELECTIVITY

CABINETS THAT ARE "WOWS"

110 TO 120 VOLT D. C. OR BATTERY OPERATION

FOUR TUNED CIRCUITS SUPER-SELECTIVITY

TONE CONTROL ON PANEL

REMOTE CONTROL OPTIONAL

PUSH-PULL 245's

FULL-RESPONSE ELECTRO-DYNAMIC SPEAKER

THREE SCREEN-GRID TUBES

100 TO 130 VOLTS, 50 TO 60 CYCLE OR 25 TO 40 CYCLE

DOUBLE-DUAL SELECTION

FOUR SCREEN-GRID TUBES

LIFETIME DIAL

PRE-SELECTION

MAN! WHAT A RADIO!

What's new in radio? Silver-Marshall answers definitely with *everything* that's new.

The *most advertising dollars per set*—spent mostly right over *your* name. Puts an *end* to next-door and next-block competition. The *season's most beautiful* cabinets. Prices down, in the *volume-moving* class, yet well *out* of the low-profit "cat-and-dog-fight."

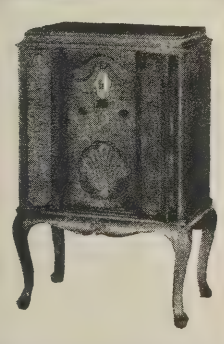
Two screen-grid chassis models: a 7-tube 4-gang—and a 9-tube 5-gang, with positive 10 kc. selectivity! Lots of treble, lots of bass, and *you control the tone* at will, with a knob. Automatic volume control on the 9—the "fading" problem solved—you can tune through loud locals without breaking an ear drum.

Put that in your pipe, and smoke out the blues. The hottest line of the season—clean protection and profits that mean "out of the red and into the blue"—the new SILVER-MARSHALL "Sharpshooters" stand out like a big silver dollar in a pocketful of street-car change!

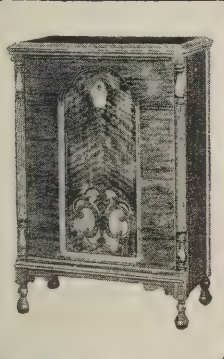
Phone your distributor or wire us to arrange demonstration.

SILVER-MARSHALL, Inc.
6445 West 65th St., Chicago, U.S.A.

All prices less tubes; applying throughout continental United States.

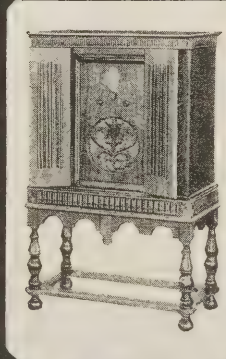


The QUEEN ANNE SEVEN: $160. Four-piece center-matched butt walnut top; front panel and overlays of Carpathian ash; legs of hand-carved walnut. 7 tubes: 3-'24, 1-'27, 2-'45, 1-'80.



The PRINCESS: $135. Top arch of Australian laurel; side panels of genuine African mahogany; top of four-piece center-matched walnut. 7 tubes: chassis identical with Queen Anne Seven above.

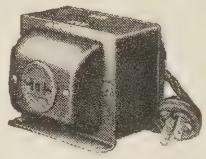
The QUEEN ANNE NINE: $185. Four-piece center-matched butt walnut top; front panel and overlays of Carpathian ash; legs of hand-carved walnut. 9 tubes: 4-'24, 2-'27, 2-'45, 1-'80.



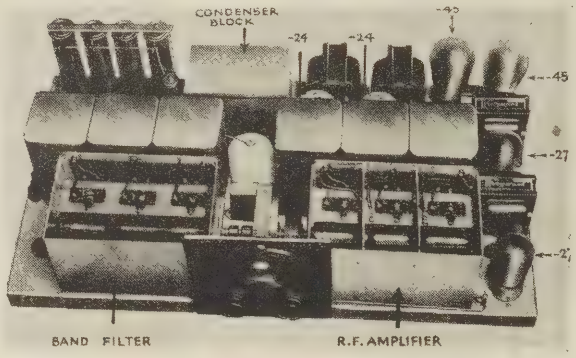
The ELIZABETHAN: $225. All walnut with linen-fold overlay panels of solid black walnut. All cuts are carefully selected for color and figure; finish throughout follows the finest practice of furniture craftsmanship. 9 tubes: chassis identical with Queen Anne Nine above.

SILVER-MARSHALL RADIO EXTRAORDINARY

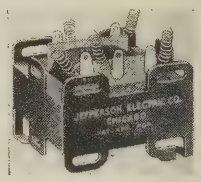
Special RADIO TRADE-SHOW Section



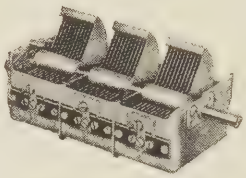
Jefferson Electric Co.
Auto Transformer



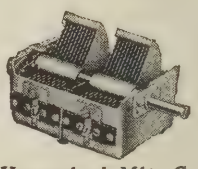
Hammarlund Mfg. Co.
DC HiQ-30



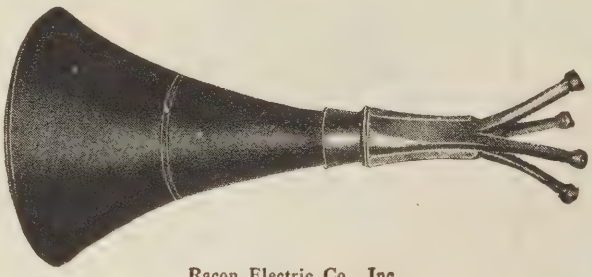
Jefferson Electric Co.
No. 372 Universal Tapped
Replacement Audio Transformer



Hammarlund Mfg. Co.
3-Gang M-Type Condenser

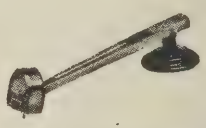


Hammarlund Mfg. Co.
2-Gang M-Type Condenser

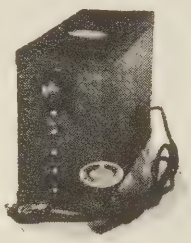


Racon Electric Co., Inc.
Aeroplane Horn

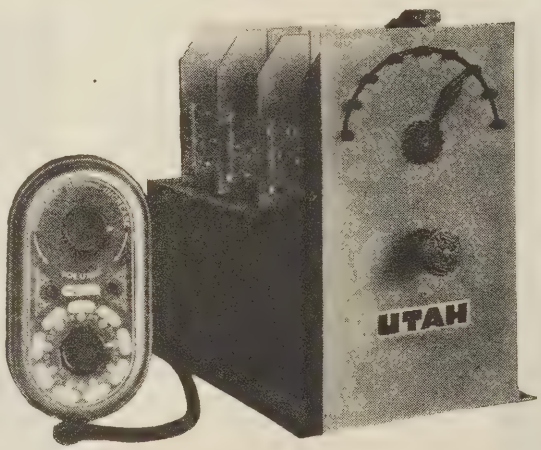
Samson Electric Co.
Type Q Qualpensator



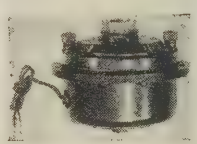
Wholesale Radio Service Co.
Phonograph Pickup



Tobe Deutschmann Corp.
"B" Eliminator



Utah Radio Products Co.
Electronic Remote Control Unit



Racon Electric Co., Inc.
Baby Dynamic Unit

National Carbon Exhibit

Among the interesting and educational exhibits, at the Radio Trade Show, was that of the National Carbon Company, where was demonstrated the making of the stems for the Eveready Raytheon four-pillar radio tube, in a special tube-making machine, while on each side of the machine were displays of Eveready layerbilt "B" batteries and assembled Eveready Raytheon tubes. Receiver and television tubes were included in the display.

A New Burtex Diaphragm

From the Stevens Mfg. Corp. comes the announcement of a new impregnated cloth diaphragm, known as Burtex, available in any size, shape, or degree of stiffness. According to the engineering staff of the manufacturer the new diaphragm is provided with a special waterproof finish, which under test has held water for fifty hours without signs of leakage, also not only is the diaphragm waterproof, but it is unaffects by heat, cold, salt air, etc.

A Resistor Guide

The International Resistance Company, 2006 Chestnut Street, Philadelphia, Pa., has compiled a collection of data prepared in booklet form under the title "Resistor Replacement Guide."

Copies of this guide may be obtained upon request, and periodically additional data sheets will be mailed to owners of the book, giving circuit diagrams and resistor values of new receivers, as well as popular experimental circuits now in vogue.

REPRODUCING a nation's entertainment

The greatest tribute ever paid to any product of the radio industry. . . . Reproducing a nation's entertainment. . . . Approval voiced so effectively by leading engineers and critics that Jensen Electro-Dynamic Speakers are now more widely used than ever before. At the Atlantic City R. M. A. Trade Show more receivers were equipped with Jensen Speakers than with any other make. . . . Designers and engineers of talking-moving picture, public address and allied apparatus have also voiced their approval, particularly of the new Jensen Auditorium, with 12 inch cone, and the Auditorium, Jr., with 10 inch cone, Speakers. The new model Jensen Concert Speaker has been designed particularly for use in radio receivers. . . . Builders of custom made radio receivers are particularly appreciative of the uniform frequency response, sensitivity and brilliance of all Jensen Electro-Dynamic Speakers. . . . All of these new speakers are the culmination of Peter L. Jensen's own genius and twenty years of experience. All are available for AC or DC operation from any convenient source of power supply.

JENSEN RADIO MANUFACTURING CO., 6601 S. LARAMIE AVE., CHICAGO, ILL.

Write immediately for new Jensen Folder No. 29 which gives complete information, response curves and other technical data on all three of these new Jensen Electro-Dynamic Speakers.

New Model DA-7
JENSEN AUDITORIUM SPEAKER
List Prices, $45.00 up

New Model DA-9
JENSEN AUDITORIUM, JR., SPEAKER
List Prices $30.00 up

New Model D-8
JENSEN CONCERT SPEAKER
List Prices, $27.50 up

Jensen Patents Allowed and Pending. Licensed under Lektophone Patents.

three new Jensen ELECTRO·DYNAMIC SPEAKERS

"There's safety in numbers" say Service Men!

The fact that more Service Men use Durham Resistances for replacement work than any other resistance unit made today means that YOU can count on Durhams to exactly meet your requirements . . . and meet them without "kickback." Over one and one-half million are used monthly, both by radio manufacturers and service men, because of Durhams' greater accuracy of stated ratings, greater uniformity and greater dependability in actual service. Data sheets on all popular types and values sent promptly on request.

DURHAM METALLIZED
RESISTORS & POWEROHMS
INTERNATIONAL RESISTANCE CO.
2006 Chestnut Street, Philadelphia, Pa.

W2XBQ Flies to Bermuda

(*Continued from page* 13)

considerably. In another second the "Pilot Radio" was on the step, the bumps becoming sharper and sharper as the air speed indicator rose from fifty to fifty-five, sixty, sixty-five, seventy, seventy-five miles an hour. One more sharp rap on the pontoons and we were off. We gained altitude rapidly and cleared the bridges in good style, Post tagging along with us as an escort.

Half-way down the East River, I crawled aft into the radio room, let down ninety feet of antenna and called WHD, the New York *Times* radio station, and

Located aft the main control cabin is the radio outfit. Here is Zeh Bouck, radio engineer and author of this story, at the key of the transmitter

sent my first message at 9:54 to Grover Whalen, thanking him for the coöperation of the New York City police who had helped us in getting under way from North Beach. At 9:55 we announced that we had swung into our course just off Staten Island, heading alone a line of buoys that run 138° true. At 9:58 we took our departure from Scotland Light Ship.

About this time, WHD wanted a list of the provisions on board. We carried rations for five days, and I radioed the following:

"Rations on board consist of two broiled chickens, four boxes whole wheat crackers, five pounds chocolate, twelve oranges, five gallons water, one quart Scotch."

This message was published as transmitted, and the last item, for some unknown reason, created a bit of excitement. This was, I must assure you, a perfectly legitimate part of our medical stores. And, by the way, what was left of the Scotch was given to Reggie Darrell in Bermuda as a souvenir. We autographed the label and he drank the rest. It may be encouraging to some of my readers to know that Reggie declared the Scotch excellent, and quite on a par with the Bermuda variety.

About this time Yancey wanted to take a sight, which was a most efficacious way of shutting down the radio. In taking sights, Yancey opened the top of the plane, admitting a hundred-mile-per-hour blast of cold wind that wreaked havoc with the papers in the radio cabin, to say nothing of the good right hand.

Sights are taken from an airplane in pretty much the same way they are from a ship, only in bumpy weather, such as we were experiencing, by the way, it is considerably more difficult. A bubble sextant is generally employed, which provides an artificial horizon. Captain Yancey used Longines chronographs, which are pocket chronometers to check time. Three chronographs are carried so that, if any one of them changes its daily rate of variation, it is immediately identified by reference to the other two. Our first position report was radioed in at 11:35 a.m., New York time, as follows:

"At 16:07 Lat. 39:31, Long. 72:50, course 38, true speed 76 knots."

And so went the day. We were in constant contact with WHD, signals at both ends showing absolutely no diminution as the "Pilot Radio" pushed the miles away with the backwash of her prop. As evening approached, it appeared doubtful if we could make the Islands before dark, due to the fact that our speed had been cut considerably by unfavorable winds. A landing in Bermuda at night was a hazardous possibility, and we went into a quick huddle. I told Iversen, who by the way did yeoman service at WHD beyond praise, that if we did sit her down, I'd sign off for the night, rather than rig an emergency antenna to the wing tips, and we'd "see" him again shortly after five the next morning. At 5:20 we sent the following: "If we don't see the Islands pretty soon will set her down for the night. If we have to set her down for the night, don't let anyone worry about us. The sea is like a lake."

At 5:50 we signed off with: "Setting her down right now. Position sixty miles

The Pilot's Crew
Bouck, Yancey and Alexander

north of Bermuda. Tell everyone not to worry. Please notify my wife and Goldberg. Sea calm, very. Will continue to Bermuda in the morning. Did you get all? See you five a.m. tomorrow."

And Bill set her down. From above, the sea may have looked "calm, very." But close to the surface it was another proposition. It took the finest sort of piloting, and Alexander had it, to put her down on that heavy ground swell without a crack-up. The Edo pontoons stood the gaff perfectly. As we came to a stop, broached to on a rolling sea, Bill acknowledged our congratulations with:

"Gentlemen, I'm going to be sick." He was.

A half hour later it was pitch dark,

(*Continued on page* 73)

W2XBQ Flies to Bermuda

(*Continued from page 72*)

with only the stars and the stingy sector of a pale moon. This set around nine o'clock. We maintained three watches when we weren't sleeping. Yancey slept well. I dreamed of railroad trains and Bill of stomach pumps. We sighted the lights of a steamer at three different times, and finally, considering the possibility of its being a ship out from Bermuda to look for us, signaled her with a Very pistol. Two hours later she hove to. At first we talked with blinker and then hailed her. She was the *Lady Somers,* requested by Bermuda to keep a weather eye cocked for us, and too much credit cannot be given her master for his fine seamanship and sportsmanship. We requested that she report that everything was okay with us and that we would proceed to Bermuda at dawn.

First Successful Ocean Take-Off

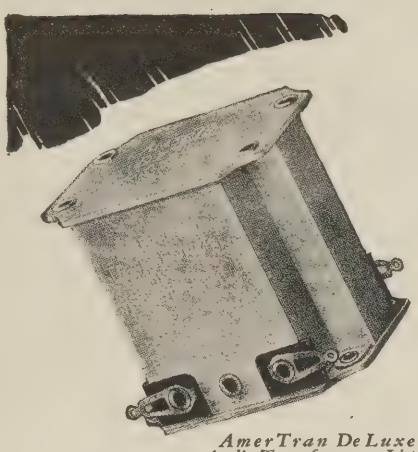
At daybreak we cleaned up the cabin a bit, tightened up a stay wire on the pontoon struts that had been loosened in the stress of landing, and took off. Here again Bill showed his mastership of a ticklish job, and for the first time in the history of flying a plane forced down in the middle of the ocean took off again.

Five minutes later I came in for the greatest thrill in my life. I reeled out the antenna, gave WHD a short call, threw the switch over the receiving side, and he was back at me in an instant, as loud and clear as when we were over the East River! This was at 5:50 a.m. New York time. A half dozen messages flashed back and forth between the "Pilot Radio" and the New York station. Iversen told us that the more flagrant of the New York papers had given us up as lost, which news amused the lads up forward. At 6:17 we sent through the following message:

"Bermuda sighted dead ahead at 6:15 New York time about thirty miles off"—a simple but eloquent tribute to the finest aerial navigator in the world, Captain Lewis A. Yancey.

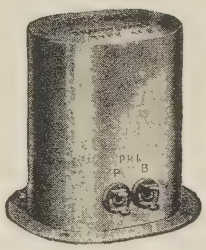
Conclusion—From the radio point of view, one of the most interesting observations was the absence of skip-distance effect. In a pre-flight conference with Fred Meinholtz, engineer in charge of the New York *Times* station, we roughly guessed that the signals from the plane would be lost at about five hundred miles out. It seems apparent, and reasonable, that the distance with which the skip-distance effect becomes noticeable is a function of the altitude of the radio station.

There seems little necessity for carrying long-wave transmitting equipment on trips of this nature. An airplane flying over water should be *in constant contact with a land station*—a contact which it seems definitely established is best maintained via short waves. In case of emergency, the SOS can be most expeditiously handled by the shore station, without the loss of time and general confusion that often accompanies a distress signal transmitted directly from sea. The elimination of the added weight makes it possible to increase the power and efficiency of the short-wave transmitter.

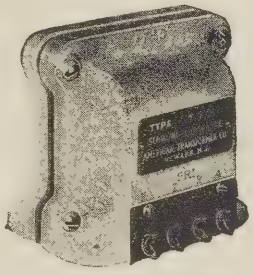


AmerTran De Luxe Audio Transformer—List Price $8.00. Type 151—Between one input and two output tubes—List Price $12.00

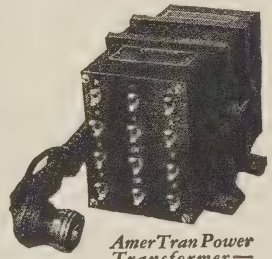
Bring *the Studio to your* Home



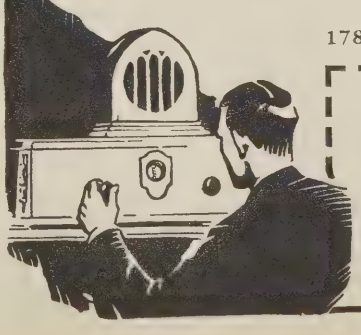
Type AF-8 *Audio Transformer—Either 1st or 2nd stage audio—Turn ratio 3½—List Price $5.00*



Type 710 *Audio Transformer—Between two input and two output tubes—List Price $20.00*



AmerTran Power Transformer—Type PF-245A—List Price $22.00



There is no excuse for imperfect radio reception. But even today, many receiving sets fail to reproduce music and the speaking voice in true tone identical with the range of pitch and the rich fullness of sound quality as broadcast in the studio.

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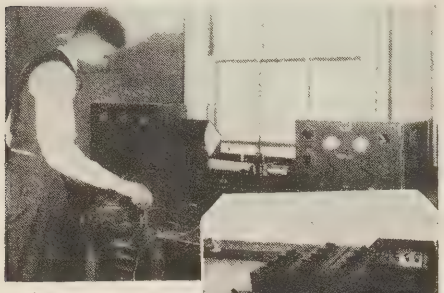
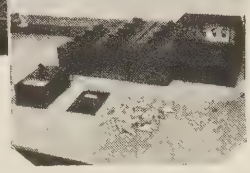


A corner in the laboratory of the National Company at Malden, Mass., where some of the best radio equipment is designed.



A standard bridge in the National Company's laboratory where every resistor is tested before it is used. While the manufacturer's tolerance is an average of 10%, actual tests have shown Lynch Resistors to have a tolerance of about 5%.

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Cascaded Output Systems

(*Continued from page 35*)

impedance of the usual power amplifier being low, so that, contrary to the usual capacity-coupled system working out of a high impedance tube, our grid leak can be of low value and thus avoid the derogatory timing effect encountered with attempt to use high grid leak values when working as ordinarily out of a high impedance tube.

The second point of selection of signal current potential for the grid of VT2¹ of interest involves a material increase for the auxiliary tube grid potential over the principal tube, we having noted best results when the grid potential of the auxiliary tube is increased to about 85% of the total output potential of the principal tube VT2.

In this case the system acts almost wholly as a cascade amplifier for comparatively weak signals, the auxiliary tube doing practically all the work on the output transformer because of excess grid potential until the input signal is increased to where the auxiliary tube overloads or saturates. The overall amplification in the range below overloading of the auxiliary tube is high, as we have practically the total cascaded amplifying ability of both output tubes.

Somewhat beyond the overloading of VT2¹, tube VT2 still works on the straight portion of its output characteristic curve, supplying undistorted signal energy to the output transformer for combination with the overload energy coming from VT2¹. When VT2 also reaches overload the system is wholly saturated. Curve 1 of Fig. 2 illustrates the several stages of operation and the results of them.

In Fig. 2 abscissæ represent energy input to the system of Fig. 1 and ordinates the corresponding energy output. The straight portion of graph 2 from origin 0 to bend *a* is had before overloading of VT2¹. There appears to be another straight portion between the bends *a* and *b* over the range in which VT2 is not overloading. Beyond bend *b* saturation of the system is had.

Dotted curve 2 in continuation of the initial straight portion of graph 1 shows a result had when the signal current potential for the grid of VT2¹ is taken from a resistance connection between the anodes of VT2 and VT2¹ in lieu of the arrangement shown in Fig. 1. Here we find a tendency to extend the range of apparent undistorted output of the system as shown by graph 2. In other words, this second form of connection seems to bring in some corrective factors to make for an improved system as far as total output ability is concerned.

Casual inspection of the cascaded output system might suggest some similarity to the so-called "phase reversing tube" occasionally used to obtain push-pull operation when working from a high impedance source in that VT2 of our cascaded output system performs the function of the so-called phase reversing tube. Analysis, however, shows that our cascaded output system is radically different in that the input and output circuits of VT2 are at least 30% coupled, which fact would normally lead one to believe that the system is regenerative. In actual practice, no sign of any oscillation is ever encountered and no regenerative peaks are found in its frequency discrimination curve.

Fig. 3 shows the cascaded output system applied to a two-stage direct coupled system of a form frequently described by us in our previous articles. VT1 is the usual −24 tube direct coupled to a pair of type −50 tubes set up in a cascaded output system to deliver the output signal energy to a push-pull transformer OT.

The constants of one system we have constructed are as follows: R3, 50,000 ohms; R1a, 500 ohms; P, 500 ohms; R1d, 3,700 ohms; Rc, ½ megohm; R5, 100,000 ohms; R6, 250,000 ohms; R9, 200,000 ohms; R10, 100,000 ohms; R11, 4,700 ohms; Chb, 2 microfarads; Ck, 4 microfarads; filter output potential B— to B+, 650 volts.

The fields of dynamic speakers may be inserted in either of the positions of resistances R1d and R11, or in both positions so that two speakers may be operated, the −50 types of tubes providing adequate field current and having adequate output ability for operating two speakers. In this connection, caution is made that all speaker fields are wound with copper wire having a high temperature coefficient, so that after these fields are fully warmed up by excitation, their resistances increase about 15%; that is, that a 2,200-ohm speaker field may become 2,500 ohms when hot. Allowance must accordingly be made for this in designing the resistance network when speaker fields are included.

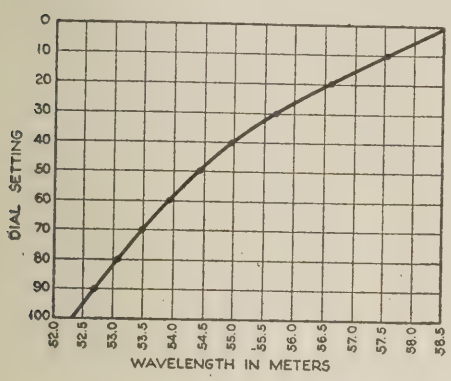
In the system of Fig. 3, the auxiliary tube VT2¹ is direct coupled to the output of the principal output tube. The cathodes of the two output tubes should be on separate heater windings. In this way the plate currents of the two tubes do not merge to flow through a common resistance arm, so that the stabilizing of each of the output tubes is independent of the other. If the output currents are merged, then the stabilizing must be based on the sum of the two currents. For example, in the case of two −50 output tubes, the total current is about 100 milliamperes. If merged and stabilized for 100 milliamperes, the stabilizer cannot differentiate between a condition where each of the tubes is drawing 50 milliamperes and a condition where one tube is drawing say 60 milliamperes and the other tube 40 milliamperes. This separation of the cathodes of the two output tubes, and therefore their currents, requires the condenser Ck connected between the cathodes of about 4 microfarads. Since there is no d.c. potential across condenser Ck, a low potential cheap condenser suffices for the purpose.

Since the cascaded output system introduces a substantial increase in amplifying ability over the straight-line direct coupled system, it is apparent that it will permit of using less preceding radio-frequency amplification in order to maintain over-all gain in a radio receiver.

Grid-Dip Meter

(*Continued from page 16*)

in the ether not only the fundamental wavelength of a transmitting station but also its first, second, third, fourth, etc., harmonic. For instance a station whose fundamental wavelength is 300 meters (1000 kilocycles) transmits harmonics of 2000, 3000, 4000, 5000 kilocycles corresponding in wavelength to 150 meters, 100 meters, 75 meters and 60 meters. So by setting up a simple three-circuit regenerative receiver and tuning it to the 300 meter station it is possible to click the test oscillator against the receiver circuit (which should be regenerating) noting by the loudness of the clicks in the phones attached to the receiver and the relative position of the test oscillator's dial as it goes down in wavelength (up in frequency) which harmonic the oscillator is clicking with. This is not so simple as it sounds and requires a bit of patience and care on the part of the fellow who is conducting the calibration procedure.



One other means of obtaining accurate frequency measurements by which to calibrate the test oscillator is to make up a simple coil-condenser combination, winding several coils to cover a number of wavebands and having them of the plug-in type. Then send the whole outfit to the Bureau of Standards at Washington, D. C., where for a nominal charge these coils will be accurately calibrated, the charge being made at so much per calibration point. For further information on this particular subject a letter addressed to the Bureau is advised.

The parts used in the grid-dip meter described here are as follows (although if it is desired other parts of similar electrical characteristics may be substituted, at the reader's risk):

One Hammarlund Midline Condenser, .00014 mfd., C1.
One Set of Coils, as described in Fig. 4.
One Socket.
One Amperite, 4V199.
One Flechtheim Bypass Condenser, 1 mfd., C2.
One Yaxley Rheostat, 25 ohms.
One Weston Milliammeter, 0 to 1.5 mils.
One Coil Mount with tip jacks, as shown in Fig. 5.
One –99 tube.
One 22½ volt B battery.
Two 4½ volt C batteries (connected in parallel).
One Hammarlund Hi-Q Metal Box.

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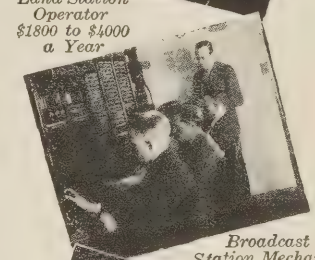
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RADIO TUBES

Some Types of Hum

(*Continued from page* 17)

be considerable in special cases.

First Audio Plate Ripple, Grid Ripple and Filament Hum. These are measured as previously described for the power tube by the use of d.c. filament, plate and grid batteries.

First Audio Input Induction. This also is measured in the manner already described for the power tube; that is, with power and first audio filament, plate and grid voltages, obtained from batteries, and the first audio transformer shunted by a resistance equal to the detector tube plate resistance. If magnetic or static induction is present, this may now be measured. If it is magnetic in character, this may be determined by unmounting the transformer and removing it to a distance, or orientating or preferably both, to determine the source of induction; if it is static induction, this may be determined, although not so easily, by placing the first audio tube in a separate unmounted socket properly connected and moving both tube and transformer away from the high a.c. or pulsating sources. Magnetic induction into the tube itself may also be determined by this test, if a certain amount of good judgment be used in analyzing its results.

Plate, Grid or Filament Hum of Detector Tube. These may be measured by employing again the same general methods above described for the first audio and power stages except, of course, that if grid detection is used no "C" battery is necessary, the grid leak being shorted instead.

Modulation. To measure modulation hum, operate detector and audio amplifier wholly on batteries, remembering, as before, to substitute dummy loads for tubes where these are removed from the power supply circuits. Then tune in a strong unmodulated carrier, preferably from a battery-operated signal generator, of say 10,000 microvolts per meter. Any modulation influences, such as plate ripple, grid ripple, or tube modulation, produced by internal or external causes, will set up a hum, the cause of which can be found as before, by the substitution of batteries or by moving suspected external sources of magnetic induction into the tubes themselves, such as power transformer or a filter choke.

While it is possible to suggest alterations or to elaborate still further upon this suggested procedure, I believe a sufficiently complete idea of the general method has been given, so that the various causes of hum may be tracked down and isolated by this process of elimination. As before stated, the first step in hum elimination is to determine its cause; then, ordinarily, remedies will suggest themselves.

Minimizing Induction Hum Effects. The hums caused by induction require very great care in elimination, particularly in receivers with high-quality amplifiers, where available space is limited. When extremely compact designs are required the designer invariably experiences difficulty with induction.

It is not my intention here to develop complete designs; but I will present some of the more important design methods that my experience has shown to be of value.

The preceding discussion has indicated that it is advisable to allow plenty of distance betwen the sources of inductive disturbances and those parts of the receiver most sensitive to them. In compact receivers the magnitude of the effects are much greater and therefore require much more careful design and workmanship. For example, a first audio transformer, when mounted within a few inches of the power transformer, or first filter choke, may cause little or no hum if both power transformer and audio transformer are located in precisely the correct locations and properly orientated. However, a displacement of a small fraction of an inch of either may destroy the condition of minimum coupling and cause a really objectionable hum to be picked up.

One method of reducing this induction in compact designs is to house the emitting source or the receiving device or both in suitable shields, to confine the stray fields. Ordinary sheet iron such as that used for transformer housings, while perfectly satisfactory for electrostatic shielding, is of small effectiveness for magnetic shielding. A high grade of magnetic iron or steel, such as pure soft iron, or the usual magnetic steels, is much superior; while more expensive, the very high permeability alloys, such as permalloy and others, are by far the most satisfactory. Since it is difficult to predict the direction of minimum induction from a given source of stray magnetic fields, owing to the distorting action of the steel chassis or of other neighboring magnetic bodies, the exact locations of power transformers, chokes and audio transformers can hardly be predicted from theoretical considerations alone. The placement therefore is best determined experimentally.

Although, as before mentioned, the first audio transformer is ordinarily the most sensitive part of the receiver to the straying magnetic fields, the second transformer as well as the tubes must be given due consideration also.

Electrostatic Fields. As before pointed out, those portions of the circuit and apparatus carrying high alternating or pulsating potentials above ground, must either be statically shielded, or removed to a safe distance from the sensitive input parts of the audio amplifier. The sensitivity of these points is in the following order: Detector grid input, if grid leak detection be used, detector plate, first audio grid, first audio plate, and so forth.

The most troublesome sources of this induction are again in order of amplitude, rectifier and filter input elements and wiring, primary circuit of power transformer, such as switch leads or connecting cord, and intermediate or output elements of the filter. To reduce or eliminate these

(*Continued on page* 77)

Some Types of Hum

(*Continued from page* 76)

fields as hum sources, it may be sufficient in designs with plenty of room to choose properly the locations of hum sources and hum receiving devices or wiring. In compact designs, electrostatic shielding of the sources, or of the receiving devices, or both, may be necessary.

Where leads with high a.c. potentials must pass near the sensitive points, the induction may be eliminated by the use of shielded leads with shield grounded. Shields in the power transformers are also effective. While a shield between the primary and all the secondaries is common and effective in reducing both audio and radio-frequency disturbances, originating in the power line, another between the rectifier windings and the filament secondaries is also helpful. Shield cans around the detector or first audio tubes are also sometimes useful.

Since the detector grid and input leads, including grid leak and condenser, are especially susceptible to statically induced hum, these should be mounted as close to the chassis as possible or near some other parts of the receiver or wires at or near ground potential. The easiest method is to connect leak and condenser directly to the grid terminal of the detector socket and close to the metal chassis.

If the detector plate lead to the first audio transformer be long or cabled, as it oftentimes is, with other leads carrying high or moderate a.c. potentials, the resulting induction can be eliminated by using shielded cable for this lead or for the offending source lead.

These are the more important design aids useful in the development of hum-free receivers with respect to induction hum.

When a hum persistently refuses to respond to any of these treatments, it may sometimes be neutralized by opposing magnetic or electrostatic couplings suitably chosen and adjusted

Current Comment

(*Continued from page* 31)

of people learning the code is rapidly increasing and manufacturers of automatic transmitting devices for this purpose have shown us figures indicating the growth of their sales which is truly remarkable.

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(*Continued on page* 78)

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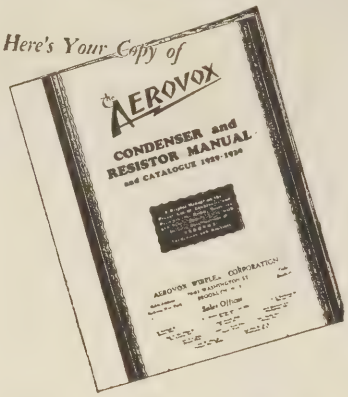

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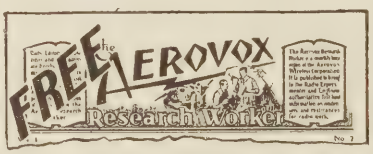

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Current Comment

(*Continued from page 77*)

observe very different results. This is brought about by great differences in the acoustics of the theatres themselves. The field of acoustics is a particularly interesting as well as a particularly difficult one.

The reproduction of perfect sound pictures depends upon so many variables and so many local conditions that we are forced to congratulate the sound engineers on the remarkable development work they have done within the past year. There is, however, very great room for improvement. Perfect reproduction in the theatre depends upon suitable recording and upon perfect installation of the reproducing equipment for the particular theatre in which the pictures are to be shown.

We are publishing a series of very important and instructive articles on this subject by Fred A. Jewell, who has done a great deal of work in this field.

A Short-Wave Super

Without any question, the superheterodyne is one of the most desirable of radio receivers. Because it is of a rather complicated nature very little has been done with it on short waves. With the number of short-wave broadcasting stations increasing and with the number of television broadcasting stations which will undoubtedly be on the air within a short time, the importance of a special short-wave superheterodyne cannot be overemphasized.

Just a year ago we had a chat about this with one of the most able short-wave engineers in the industry, and he told us at that time that he had some very definite ideas in mind for the building of a receiver. He promised that if the receiver was ever made that he would let us have a look at it before it was offered to any other publication.

Fred H. Schnell, now vice-president of the Radio and Television Institute of Chicago and formerly short-wave receiver expert for the Burgess Battery Company and the Aero Products Company, as well as member of the technical staff of the American Radio Relay League, has finished the designing and has promised the receiver to us. A series of articles describing it will begin in our August number.

Schnell, who made a cruise around the world on an American battleship and demonstrated the remarkable results which can be obtained from short waves, to the surprise of many naval experts, states that this receiver is the best thing he has ever used. Since he has used approximately every type of receiver made, we feel sure that this new superheterodyne will be well worth the serious consideration of our readers.

Tubes and Volume Controls

In a recent survey we found that the two most common causes for failure of regular manufactured broadcast receivers resulted from faulty tubes and faulty volume controls. The failure of tubes is something with which most of us are familiar and it is not as a rule a difficult job to replace them. The failure of volume controls, however, is something entirely different.

In spite of the efforts of the Radio Manufacturers' Association to induce the manufacturers to use standardized devices, at least standardized in their physical dimensions, volume controls remain varied. It is almost impossible for the serviceman to carry a stock of volume controls suitable for replacement purposes and as a rule it is necessary for him to take the receiver apart, in order to find the size of the volume control and to find its rated resistance value.

We believe that a chart indicating the type of control used in most of the important receivers and distributed generously to service men throughout the country would produce a very great deal of business for the volume control manufacturers and would, at the same time, relieve a great many radio users of the inconvenience of having a receiver completely out of operation because of the failure of one of those small devices.

Sound-on-Disc Reproduction

(*Continued from page 39*)

The wires that carry this small current —only a few milliamperes—are shown in the wiring diagram of Fig. 2. The current that is generated in the pick-up passes over these wires to the fader, see Fig. 3, the purpose of this device being two-fold. The fader serves first as a convenient means for controlling the volume level of the reproduced sound, in that the acoustical conditions of the theatre vary from one time to another due to its dimensions, architectural features, and especially the sizes of the audiences. The proper control of the volume of the sound to meet the existing acoustical condition contributes greatly to achieving natural and pleasing results.

The fader also provides a means for reducing the output of an expiring record and building up the sound level of the new record to the proper volume. An abrupt change from one record to another at full volume is very undesirable, but by the use of the fader the changeover can be made in such small steps that it is unnoticed by the audience. These changeovers are made, of course, at the end of a reel of film and at a point where very little sound, if any, is needed for the action of the story.

The fader in its simplest form is nothing more than two variable resistors, one being across one pick-up and the second across the other. It is so constructed mechanically that as one pick-up's output is cut down in volume that of the second is raised, so that you gradually fade from one into the other, which is where this device got its name.

(*Continued on page 79*)

Sound-on-Disc Reproduction

(*Continued from page* 78)

Referring again to Fig. 2 it will be seen that after the current from the pick-up has gone through the fader it passes on to the amplifier. This is, of course, an audio-frequency amplifier and may be of the resistance-coupled, transformer-coupled or impedance-coupled type. Generally the d.c. type of vacuum tubes are employed, the filament supply being from a storage battery and the plate and grid current supplied from dry-cell batteries. The last stage of the average amplifier is of the push-pull type, consisting of –45s, –50s, –210s or 50-watt tubes. A.c. tubes are used to a certain extent, as is alternating current for the amplifier's power supply.

From the amplifier lines lead to the monitor horn, which is located in the booth, so that the projectionist can check up on how the sound is coming through the apparatus and if it be in synchronism with the picture. From this he gets the various cues which tell him when to increase or decrease the volume by using the fader or when the end of the record and reel is near, so that he can have sufficient time to prepare the other projector and turntable for the next reel and record.

Other lines lead from the amplifier down to the stage where the loud speakers are in most cases located behind the screen. In some cases, the output current is reduced by output transformers located in the booth and these lines must be able to carry a relatively heavy current and small voltage. In other cases, these step-down transformers are located at the loud speakers on the stage and so these lines carry only a few milliamperes of current at 450 volts.

The loud speakers have generally the electrodynamic type of unit and are either of the cone type or use an exponential horn. See Fig. 4. In the majority of cases a dynamic unit using an exponential horn is employed, because by this means the sound can be directed to different parts of the theatre overcoming acoustical difficulties.

When the loud speakers are located behind the screen, this must be of a porous material so that the sound waves can get out to the audience with a minimum of hindrance. There are on the market at the present time several different types, but in the main they have holes which are about ⅛ inch in diameter punched in the light-reflecting material through which the sound travels. The problems represented by the use of porous screens are in the main getting a maximum amount of light reflected to the eyes of the audience from a screen which has a smaller reflecting surface (of course, every hole in the screen reduces this reflecting ability proportionately) and having a minimum amount of obstruction to the passage of the sound waves from the loud speakers out to the audience.

These are the main factors of the method of reproducing sound by the disc method in conjunction with motion pictures. Space does not permit the deeper

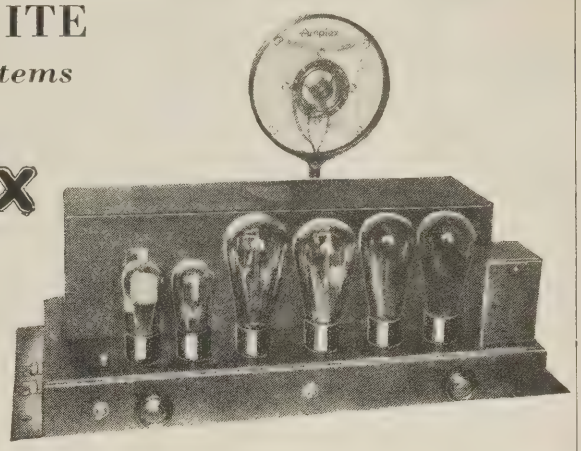
(*Continued on page* 80)

LOFTIN-WHITE

Public Address Systems

by

Amplex



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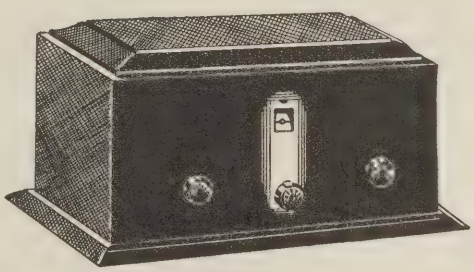

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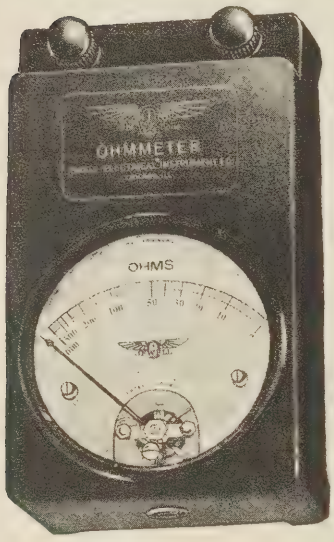

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Name _____

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The Serviceman

(*Continued from page* 48)

return SW2 to the "off" position, throw SW3 to the grid position, SW1 to the third contact point, and SW4 to the right. The voltage being applied to the grid will be found on M2. Each degree on the one hundred milliammeter scale being one-half a volt. If the grid voltage is found to be below ten volts, SW4 can be switched to the left to obtain a more accurate reading. When SW4 is in this position each division on the 20 milliampere scale is one-half a volt. In case of high grid voltages in excess of 50 volts, throw SW4 to "off," SW1 to the fourth contact and SW5 to the left. This will give grid voltages reading up to 100 volts on the 20 milliampere scale, each division being 5 volts. The plate voltages are taken the same as the grid voltages, by throwing SW3 to the plate position. With SW5 in the right-hand position, voltages may be read up to 500 on the 100 milliampere scale. In the left-hand position to 100 volts on the 20 milliampere scale. With SW5 off and SW1 on the third position, voltages may be taken to 50 volts on the 100 milliampere scale. For obtaining screen-grid voltages on any set it is necessary to use the eight-inch lead with a clip on each end, fastening one clip to the small machine screw on the side of the plug and the other to the connection used for furnishing the screen-grid voltage to the top terminal of the tube. SW3 is now placed in the "off" position, SW1 to the fourth contact and SW5 to the left and SW7 to "on." The screen-grid voltage may now be read on the 20 milliampere scale, each division being 5 volts. This completes the test taken from the socket.

To test tubes, remove one of the r.f. tubes and find the plate voltage, which is usually about 90, a desirable voltage for most tube testing. Place SW1 on the first contact and SW4 to the left. Note the reading on the 0-20 milliampere scale, by closing SW6 to the –4½-volt position, the grid swing can be noted. By consulting the tube chart furnished by the tube manufacturers, one can realize the condition of the tube. In testing the types –45 and –50 power tubes, SW4 should be in the right-hand position and SW1 on the second contact. As these tubes draw more than 20 milliamperes, it is of course necessary to use the 100-milliampere scale.

To complete the instructions for the operation of this test unit, a short explanation on the modulated oscillator will not be amiss. To use the oscillator, throw the SW3 to the "closed" position, SW6 to the left-hand position and SW9 to either the 215 or the 350-meter position, depending on whichever signal is desired. Of course, all other switches are in the "off" position, and the test plug removed from the set when operating the oscillator. By the use of a –99 type tube in the socket, when the oscillator is in use, a "C" battery can be made to function as an "A" battery, by means of the switches, as shown. The necessary "B" voltage is provided by a 22½-volt "C" battery which can readily be mounted in the base of the carrying case. A rheostat for the control of the filament potential to the tube will prove handy, but was not used in the original set. Little need be said on the use of the oscillator in the balancing and aligning of receivers, as much has already been published in former issues of RADIO NEWS. However, a few pertinent points may be of help to those who have had no experience in the use of this type of equipment. Place switches SW6 and SW9 to the left and close switch SW8.

1. Use earphones or resonance indicator for balancing. (Never use a loud speaker.)

2. Always balance first with SW9 in the left-hand position, or on a low wavelength (about 215 meters).

3. When balancing by means of a special balancing tube, be sure the elements are unimpaired.

4. Be sure that the oscillator is far enough away from the receiver to tune sharply.

5. Always balance from the last r.f. tube, back to the tube next to the antenna circuit.

6. When small compensating condensers are placed across the main tuning condensers, balance with the compensators at about one-half capacity.

7. After balancing at 215 meters swing SW9 to the right-hand position and line condensers at about 350 meters.

SW7 is shown here as a double-pole, single-throw switch and was used as it was on hand, but it can, of course, be just as well a single-pole, single-throw switch, as its only function is for the screen-grid voltage delivered at the socket. The serviceman may find the lack of an a.c. meter in the order of 150 volts a slight handicap, but by checking the filament voltage at each socket and noting whether the voltage runs over or under what the

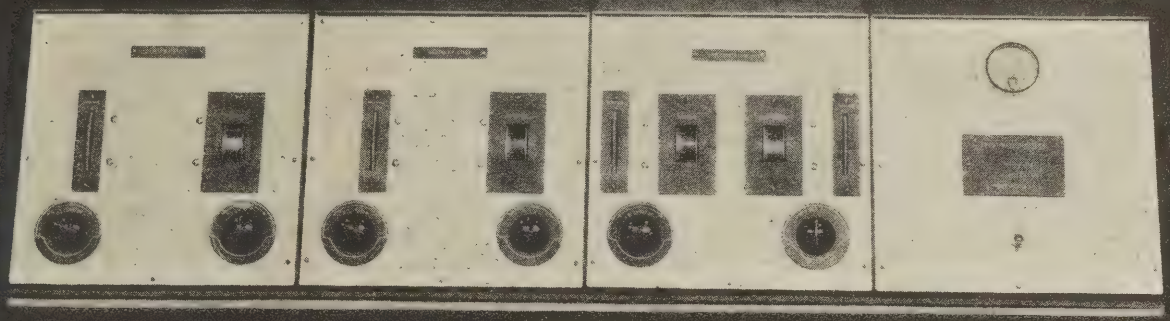
(*Continued on page* 82)

Sound-on-Disc Reproduction

(*Continued from page* 79)

delving into more of the problems and a more extensive description of the apparatus employed. The main object is to acquaint the reader with the bare facts so that he can compare this system with the second—sound-on-film—which is to be described in the next issue of RADIO NEWS. The acoustical problems that the talkies have brought up are many and some of these will be discussed in forthcoming issues. These problems must be overcome before the motion-picture industry can settle down securely in its position as the fifth largest industry and it is up to the men who are well-versed in electrical acoustics to bring this thing to pass.

A NEW POWERFUL SHORT WAVE RADIO



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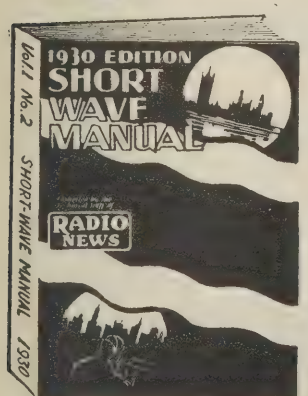

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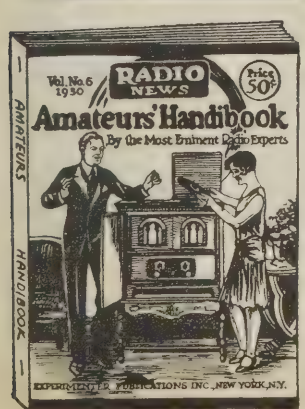

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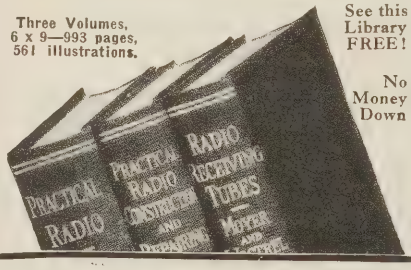

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The Serviceman

(*Continued from page* 80)

tube calls for, it is easy to estimate if the line voltage is high, low or normal.

A warning might be in order, relative to the resistances R1 and R2. These should have a rating in milliamperes somewhat higher than the highest scale reading of the milliammeter.

The accuracy of the voltage readings will, of course, depend entirely on the accuracy of the resistances used.

All of the jacks, with the exception of J1, are for the external use of the meters. Many uses other than those given here can be found for this inexpensive tester and it should earn its cost many times over in the first few months of its use.

The following parts were used in the original set, but the constructor will naturally use his own choice as to the parts he uses. They should, however, be of like physical and electrical characteristics to the following:

M1—Readrite 0-15 a.c.-d.c. voltmeter.
M2—Readrite 0-20-100 d.c. milliammeter.
1 UX Benjamin socket.
SW1—Yaxley 5-pt. inductance switch.
SW2, 3, 4, 5, 6, 7, and 9—Yaxley No. 30 3-position switches.
SW8—Yaxley d.p.s.t. switch.
C1—.0001 mfd. fixed condenser.
C2—.00025 mfd. fixed condenser.
C3—.00025 mfd. rigid condenser.
L1—140 m.h. inductance (see text).
R1—Durham 500-ohm resistance.
R2—Durham 5,000-ohm resistance.
R3—Durham 4-megohm grid leak.
8 Yaxley pup jacks.
3 Yaxley pup plugs.
1 Readrite No. 24 adapter (for Kellogg type tubes).
1 Readrite No. 54 adapter.
1 Readrite No. 45 adapter.
1 Readrite No. 19 adapter.
1 Readrite No. 20 adapter.
1 handle cap attachment plug.
1 –99 tube base.
6 ft. 5-wire battery cable.
2 test probes.

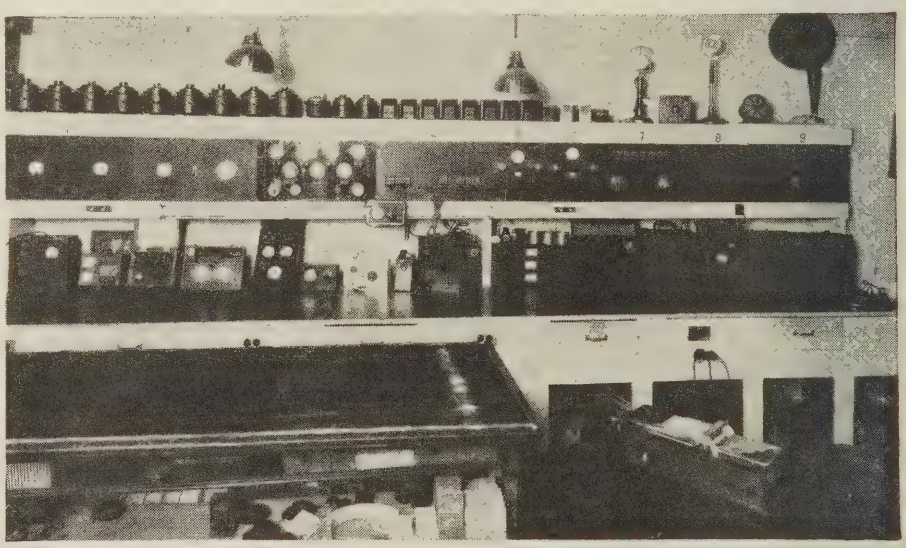
Note: The wiring of the test set permits the testing of type –22 and –24 type screen-grid tubes, but for those who prefer, the Readrite Company makes two adapters for this purpose, Nos. 122 and 123. One other adapter is of great value —Readrite No. 145 for testing double-plate rectifier tubes. These three adapters may, however, be dispensed with.

On Short Waves

(*Continued from page* 49)

and coverage. From 50 watts the transmitter has been increased to 500 watts and the power is now being further increased to the full 5,000 watts authorized by the license granted by the Federal Radio Commission.

Ten Dollars for a "Lab" Photograph!



This month's ten-dollar award for a photograph of a well-equipped serviceman's test bench and shop goes to Mr. M. C. Mancill, of the Hall Music Co., Inc., of Abilene, Texas. The photograph shows various types of test apparatus, including a supply of dynamic speaker units, microphones, tube testers and checkers, radio and audio oscillators, set testers and miscellaneous meters, a veritable experimenter's paradise.

Magic by Radio

(*Continued from page 37*)

spark-gap, and are led down along the legs through the trousers.

Right here it may be well to point out that the antenna wires (which may be made of ordinary lamp cords) should be very well insulated with a double layer of insulating rubber tape. If this simple precaution is not observed, you will experience rather unpleasant shocks due to the voltage step-up action of the spark coil. The voltage generated at the secondary terminal of the spark coil is on the order of a couple of thousand volts and is rather unpleasant when you experience a shock.

Position Is Important

Operation—In operating this apparatus it is well to keep in mind the fact that at all times the person doing the operating should not be very far removed from the table on which the receiving apparatus is mounted. The range of the transmitter is only a few feet and if you get too far away from the table you will not obtain beneficial results. It will be necessary to develop a certain finesse about going about the business of presenting your little speech in connection with the performing of any particular trick, so that you can mask the attempt to turn the switch which selects the various effects. By the way, this switch should be placed under the edge of the table so that when you go over to it to remove, say perhaps, the light and meanwhile explaining that the next thing you are going to do for the audience is to make the skull's jaw move, then with a bit of sleight-of-hand you will have to move the contact switch No. 11 to the point which is the correct one for operating the magnet which actuates the skull's jaw.

Practice Makes Perfect

Some experimentation will be necessary before you can obtain the correct placement of the coherer in relation to the striking arm of the clockwork. It will be necessary to try several placements of the coherer so that just enough force is obtained from the striking arm to disturb the condition of the iron filings in the coherer and thus create periodically a condition of a broken circuit. Also, it will be necessary to make several adjustments of the magnet No. 5 so that just the right tipping arrangement will be obtained on the clockwork release. All of this will come after several experiments and trials have been made to put the apparatus into proper operating condition.

Simple, But Effective

And so, when all is said and done, what you will have is a simple radio apparatus which will enable you to perform tricks of magic and so astound your friends with your untold magical powers.

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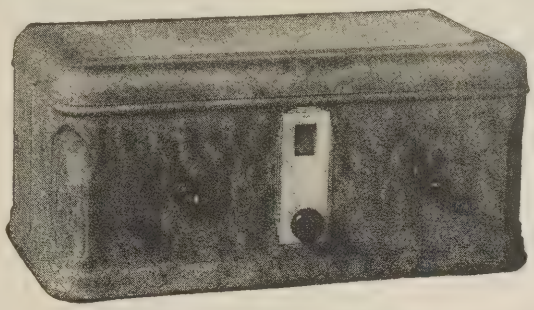
TWELVE MODELS, A.C. or battery—kits or complete receivers for shortwaves or television. All equally efficient and some especially designed for tropical countries.



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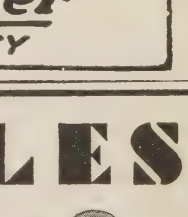

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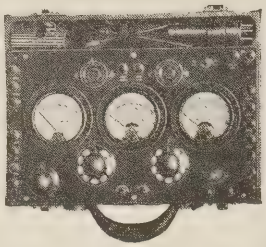

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Preferred by all leading dealers and service men because of its dependability, ingenious design providing ease of operation, compactness, and light-weight portability.

The Model 547 makes all the required tests on any A. C. or D. C. receiving set. Durable Bakelite case and fittings. 3¼" diameter instruments.

Valuable loose-leaf Instruction Book containing electrical data for practically every set on the market furnished with this instrument. All purchasers of the Model 547 receive this free additional service—kept up-to-date as new information is published. Write today for full description of this instrument and accompanying service.

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has a capacity equivalent to 54 feet of aerial wire, 50 feet in the air, and contains gold-plated wire. This little wonder filtered aerial will improve radio reception on most sets, as it helps to eliminate many noises that are troublesome to radio enthusiasts.

This small compact aerial (being but 2½ by 5 inches in size) is small enough to be placed anywhere. It is absolutely non-directional, non-corrosive, will not wear out, and never needs to be replaced. Does not connect into a light socket, therefore there is no AC hum or noise. The Wellston Gold Test Aerial eliminates all lightning hazards. Not fully efficient on battery sets.

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Price, $2.50

Avoid Imitations and Substitutes

Wellston Radio Corpn.
Dept. R.N., St. Louis, Mo.

What Price Remote Control?

(*Continued from page 33*)

point about remote dial tuning is this: Remote dial tuning reproduces at each box the vernier adjustment obtainable by hand tuning at the set. Consequently, distant stations can be tuned in as readily as locals.

However, pre-selection devices must be tested with the utmost thoroughness to ascertain if the mechanism will bring in the selected stations repeatedly at the exact resonance points. If the adjustments are subject to wear and play, the customer will soon complain that the quality has become poor, or that the tubes are old, when the only fault is that the control is not tuning the set perfectly.

The sharper the tuning, the greater the precision required of the pre-selection device. Again, such devices may be entirely satisfactory in cities where there is plenty of local broadcasting, yet fall down entirely in locations where the nearest station is fifty miles or more away.

Any kind of motor-driven control, particularly if it has a commutator-type motor, will make the most tremendous racket in the loud speaker. Each spark causes the control wiring to transmit untuned oscillations which are picked up by the radio antenna, amplified by the set, and come out of the speaker in a deafening roar. It would seem as if they could be filtered out in some way, but whatever is done in that respect, the extreme sensitiveness of screen-grid sets hunts up these noises and makes the most of them.

One solution, when pre-selection is employed, is to short out the speaker while the control is turning the condensers. Unfortunately, with remote dial control, that cannot be done, any more than it could be done with present hand tuning methods. The only answer is to use a system which does not click.

Experience again. We had such a system which worked perfectly in New York City—absolutely free of clicks. Imagine our consternation when a set shipped to Ohio was returned because the operation of the control made such frightful noises. Tested upon its return, it seemed to be perfect.

Then we found that we hadn't heard the clicks in New York because, with so much local transmission, we had kept the volume control half-way down. In Ohio, they had to use full volume all the time. That was why we hadn't heard the noises, and why they had. So we had to start all over again, but we finally licked the clicks, but it wasn't so difficult because we didn't use a motor anyway.

RADIO NEWS has published several articles on motor boat radio sets. Installations on small boats don't involve many serious problems, and the owners are generally willing to overlook minor shortcomings.

However, when the owner of a boat costing anywhere from $200,000 to $1,000,000 pays several thousand dollars for a radio installation, he wants the last word in perfection. And he will certainly want to use the radio when the engines are running.

There is only one man in the country, as far as I know, who can engineer such equipment. He is the Geils of G. and F. Radio, in the Bronx, New York. He handled the remote control system on John Hayes Whitney's 35-mile-an-hour express cruiser, *Aphrodite*. This boat is powered with two 550-h.p. Weight-Typhron engines. Together they have 96 spark plugs. There are also several electric motors and the heavy battery charging equipment.

Yet for all this local disturbance with the engines turning up at 1,800 r.p.m. there is not the slightest trace of interference.

Similar results are obtained on the *Avalanche*, a 150-footer, costing $500,000. There are 35 sources of interference on this boat, yet they cannot be traced in the four speakers which are used with four remote control boxes located both fore and aft.

"If you are upstairs, and want one station, and I'm downstairs, and want another station, what will the remote control do about it?" This question is sometimes asked by the kind of people who delight in thinking up questions like that.

My answer is that if we can't settle it between us, I don't want you downstairs. I want to put you out.

That may exist as to the hypothetical question, but it doesn't have to be answered. What is important is the individual volume control for each speaker.

We have gone into that question carefully. Two solutions have been found. One is to use a.c. or d.c. speakers, according to the power supply, with the voice coils in parallel. Each is put as a potentiometer. Then the line is put on one adjustable matching transformer, coupled to the output of the set.

The Samson Electric Company has published data on this subject which is most helpful. That method can be employed with very little sacrifice of quality. Magnetic speakers are not recommended because of their relatively high impedance which, in such a circuit, cuts off the lows, and brings out interference noises.

For the finest quality, we use an output transformer after the detector of the radio set, for a 500 ohm line. In parallel, on this line, we put Samson amplifier units, each with a rectifier tube supplying one 224 and a 250, one amplifier unit for each speaker. A potentiometer across the input of each amplifier unit provides the volume control without any sacrifice of quality.

The foregoing is not intended as a complete discussion of remote control, but rather to bring out some of the important features that can be discovered only by actual experience in installing such apparatus and, what is most important, to bring to the attention of engineers and amateur set builders the existence of a million-dollar-customer market which is totally unexploited, although it is the most profitable of all to those who will go after this kind of business.

On Short Waves

Short Wave Editor,
RADIO NEWS.
Sir:

I have been a reader of your magazine in the old days of RADIO AMATEUR NEWS, when you used to put a cartoon on the cover like an old lady hanging clothes on an antenna, but this is the first time that I have written to you. You seem to hear so much grief with the Junk Box that I will tell you my grief and good fortune.

I first built the Candy Box and received nothing but a lot of howls and squeaks; then I purchased a copy of the Short-Wave Manual at our local newsstand and built the Junk Box short-wave receiver. Immediately code poured in by the bucketful, but no phone. After about two days of labor with the grid condenser, variable condenser, wire checkings, etc., by holding my left eyebrow just right on account of body capacity, I was able to hear WQD or C testing. All I could get out of it was that they were talking about No. 77. Next I heard some music very weak. I nearly wore out an eraser on a pencil slowly turning the knob with it. By holding one finger at a certain distance I got them fairly loud. I thought it must be England or China, only to get the announcement that it was KHJ, only half a mile away. I immediately threw the set in the corner.

But I hooked it up again several days later, turned the dial and heard good music good and clear; by bending my body back and my hands forward and twisting my head sideways they came in great. I thought it must be KFI it was so loud, but I got the thrill of my life when the announcer said it was WGY at Schenectady. Mr. Bean then took the mike and announced that it was 12:01 Eastern Standard Time, 9:01 by my watch, and they would transmit thirty minutes of television by courtesy of the General Electric Co., and I certainly got another thrill when that motor started going.

It was so loud it sounded like a vacuum cleaner in my room. I sat there the full thirty minutes listening to those signals just like I used to listen to code ten years ago when I could not read a word if it. Every time I would turn my head or bat an eye, the set would set up a terrific howl of protest, but all I had to do was to move my hand and in came the television signals. That night repaid me for all my work, as television out here is as scarce as the proverbial hen's teeth.

Since then I hear voices at various wavelengths, but it is impossible to bring them in loud enough to understand. The voices are rattly and it sounds as though they were talking through 60 cycle a.c. I think if I could get rid of that infernal howl and body capacity it will remedy it. Tonight I am going to shield the whole thing in copper.

In closing I will say that I hope your magazine does for television what it has done for radio. I doubt if radio would not still be a plaything of the amateur if it were not for your work.

Yours very truly,
H. IDE O'BRIEN.
Los Angeles, Cal.

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Eliminates Ignition and Generator Noises For

AUTO
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AIRCRAFT

Approved by Radio News Laboratory and auto-radio manufacturers after extensive tests. Endorsements of leading engineers accompany each kit.

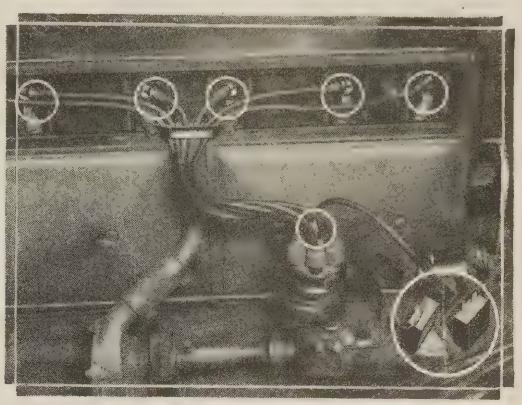

Illustration shows EX-STAT Ignition Filter System installed on a standard car. Booklet for installation accompanies each kit.

AUTO, marine and aircraft radio without a filter system is impossible, due to ignition noises. The EX-STAT Filter System is scientific—based on the experience and recommendations of the country's leading radio and automotive engineers. For the first time EX-STAT offers every auto, boat and plane owner the simplest, cheapest and most effective method of overcoming the ignition problem, when installing radio.

EX-STAT Ignition Filters, in addition to eliminating ignition noise, also cut out the noise from the generator and make it possible to use the car battery for operating the radio. Made for 4-, 6- and 8-cylinder cars. Special types for other cars, motor boats and aircraft on request. Kit contains necessary spark-plug suppressors, ignition filter and two condensers (as indicated by circles in illustration), together with diagram for easy installation and illustrated booklet describing use of EX-STAT Ignition Filter Systems in all types of cars.

When installed in accordance with instructions packed with each kit, EX-STAT Ignition Filters are guaranteed effective or your money will be cheerfully refunded, as provided for by the guarantee packed in each kit.

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Browning-Drakes always appealed to technical radio men. More Browning-Drake kits were sold than any other make.

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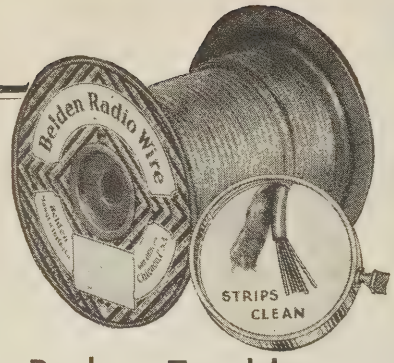

Reduce Troublesome Interference by using

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Much interference with radio reception caused by high tension wires, household appliances, and similar sources can be eliminated through the use of Belden Shielded Lead-in Wire.

Belden Shielded Lead-in Wire consists of a stranded copper conductor, with easy strip rubber insulation and an overall braid of tinned copper.

When this wire is used the aerial proper is installed out of the zone of interference. The lead-in conducts the signal energy through the zone of troublesome impulses. This lead-in is shielded so that the interfering impulses are grounded and are not permitted to interfere with the signals.

Radio service men everywhere report remarkably successful results through the use of this interference reducing lead-in wire.

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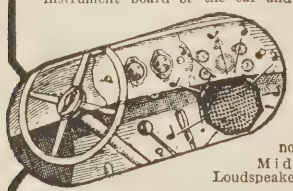

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The Experimenter

(*Continued from page* 47)

example), thus again strengthening the signals in general and the low notes in particular, and thirdly, we shall now be able to handle far stronger signals without blocking occurring.

Inductance

Of course, the inductance must be a good one of high value. Fortunately, however, most experimenters will have such an inductance to hand in the shape of a secondary of an old audio transformer put on the shelf either because of a burnt-out or an electrolysed primary, or because the result given by it when used as a transformer is not up to modern requirements of fidelity. In this connection it should not be forgotten that the fault of these old transformers was generally that the primary was too small, the secondary being, as a rule, satisfactory.

A further requirement which should appeal more especially to the short-wave amateur is that the use of a switch, Fig. 1C, to change from peaked audio amplification position A, with the result of very high amplification of the particular note chosen to high fidelity reproduction, position B, suitable for reproduction of short-wave broadcasts.

Audio Transformer

In this case an old type audio transformer must be used of high ratio and with a small primary. This primary is tuned by a parallel condenser, C1, to give a peak at the audio frequency desired. It may be preferred to make this a condenser variable so that if the ear becomes tired of one particular pitch another may be substituted. In this position, A, the first stage is an ordinary audio transformer-coupled stage with high gain in general and extremely high gain for one particular pitch being thus ideal for the reception of c.w. signals.

In the position B, on the other hand, resistance-capacity coupling is used, the secondary of the transformer replacing the usual grid leak.

It may be added that this device is also usable following a −24 tube as a detector as long as sufficient reaction effect exists. Here the stage gain on the peaked reception of c.w. signals is almost incredible (but the peak is so sharp that they must be steady) and on resistance-capacity amplification there is a distinct gain over a −27 tube as a detector.

De Forest Catalogues Transmitting Tubes

A catalogue covering the extensive line of De Forest transmitting and power rectifier audions has just been issued by the De Forest Radio Company of Passaic, N. J. The De Forest line now includes 13 transmitting and rectifying audions for oscillator, rectifier, audio amplification and radio frequency, and modulator purposes, ranging in power from 15 to 5,000 watts. Among the types are mercury vapor rectifiers, screen-grid transmitters, and water-cooled tubes, thereby covering every standard function in transmitting and auditorium amplifications. Aside from the standard broadcast reception audions, the De Forest products also include the De Forest Vis-Ion, or television neon lamp, and the photo-electric cells manufactured to exact specifications. The catalogue is available to anyone on request.

Home Lab. Experiments

(*Continued from page* 46)

current under various conditions when a C biased detector is used. Then change the circuit to a grid leak and condenser detector and again run through the tests. Determine which arrangement gives the greatest change in plate current.

Checking Selectivity

3. Check the selectivity of a single coil and condenser arranged, as shown in Fig. 3. For this test a milliammeter that will measure r.f. current is required or in place of the meter a vacuum tube voltmeter as indicated in Fig. 4 may be used. With the coil and condenser located a certain distance from the oscillator read the current or note the deflection of the meter in the plate circuit of the vacuum tube. Plot the reading of the meter for various settings of the dial on the variable condenser. Place a 10 ohm rheostat in series with the coil as shown in Fig. 5 and make the same test, being sure that the coil is located in *exactly* the same position relative to the oscillator as in the previous test. Note that the resistance in series with the coil has caused a reduction in current and that a curve showing the relation between dial reading and current is much broader. This shows that the selectivity of the circuit is poorer with the ten ohm resistance connected in series.

Plot Curves

Plot curves for all these experiments.

To the advanced experimenter the tests described in this sheet will probably appear to be not very productive—but these sheets are not written for the advanced experimenter. They are prepared for those whose hobby or business may be radio but whose ideas regarding the manner in which receivers operate may not be entirely clear. Following sheets will discuss other parts of the radio receiver and then we will talk about other subjects of considerable experimental interest, such as measuring coils and condensers, making and using simple bridges, measuring transformers, and so forth. But these things naturally follow a series of experiment sheets devoted to the radio receiver, a discussion of its various sections, what they are for, and how they work. The sheet to be published next month will describe some experiments with detector circuits.

Line Voltage Regulators

(*Continued from page 25*)

volts. Under the varying conditions of use to which these lines are subjected, that is, heavy loads in the evening when the house lights are used to extremely light loads in the early hours of the morning, the fluctuating voltage, in spite of the power companies' attempts to balance these loads, varies greatly enough to cause serious discomfort to the radio listener and many times harm to his receiver.

A sample curve of such a line fluctuation is shown in Fig. 1. This illustrates quite well how with an assumed line voltage of 110 volts the actual voltage delivered to the primary of the power transformer fluctuates from a low of 95 volts to a high of about 130 volts.

The effect of a line voltage which is not constant can be likened quite well to the early attempts to control the volume of a receiver first by means of a hand rheostat in series with the filaments of the tubes so as to obtain a reduction in the voltage applied to those filaments and second by inserting variable resistances in series with the plate supply to the various r.f. tubes so as to reduce the voltage applied to those plates. In the case of the receiver employing such systems of volume control it was the general practice to use either one or the other, but where we now deal with a line voltage fluctuating all over the lot we get both of these effects combined. In some instances such a condition might possibly be tolerated where only a reduction of volume is experienced. But think, too, of what is likely to happen if the line voltage, instead of lowering to 95 volts, suddenly rises to 130 volts. Naturally a higher secondary voltage is applied to the rectifier and the whole filter system. Most important of all, though, is the rise in filament voltage, often to a range which endangers the life if not actually burning out the filaments of these tubes. Fig. 2 shows the low and high values of filament voltage applied to a —27 tube while in Fig. 3 the conditions existing at the plate of the tube are depicted.

Fortunately the problem is one not without a satisfactory solution. Taking advantage of the property of a specially prepared resistance material when enclosed in a glass bulb and surrounded by an inert gas—to change its resistance (over a definite range) and with an applied fluctuating voltage to deliver one of a practically constant nature, engineers have evolved a unit which when placed in series with the primary of a transformer, will keep the voltage applied to it practically constant within limits.

What they have done is to take a transformer intended for 110-volt operation, rewind or tap its primary so as to deliver the same secondary voltages at a primary of 85-90 volts and with the line voltage control unit inserted in series with this primary any fluctuation of the line voltage, either up or down, will be counterbalanced by the line voltage regulator, thus maintaining the actual

(*Continued on page 88*)

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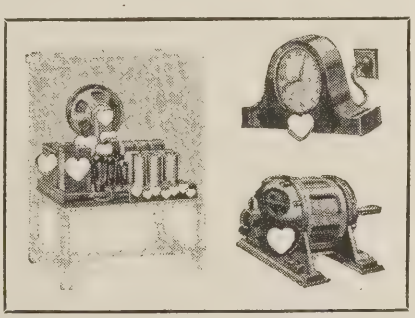
Strong Hearts win the industrial race, too!

Polymet produces tested essential parts for many successful radio receivers, motors, ignition devices, clocks, telegraph and signal systems—where electricity actuates or controls. Such wide acceptance proves these carefully made Polymet Products are Strong Hearts, too!



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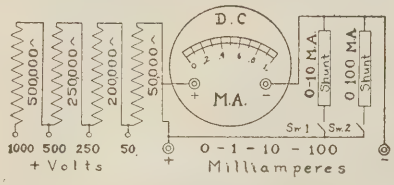

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Line Voltage Regulators

(*Continued from page* 87)

applied voltage to the primary of the transformer at a practically constant value, over a wide range of line voltage fluctuations.

A number of radio set manufacturers, taking cognizance of the conditions which exist, have equipped their receivers with power transformers whose primaries are tapped as above and have included a socket for the line voltage control unit in their chassis.

One manufacturer of line voltage controls, the Amperite Corporation, who has specialized in automatic voltage control appliances exclusively since the early days of radio, has very generously placed at the disposal of RADIO NEWS readers his entire engineering force for the solution of their line voltage problems and for the selection of the proper type of line voltage control for their particular needs.

In order to determine the proper line voltage control unit for any particular set, it is necessary to know what the current consumption of the receiver is at a measured voltage. If convenient, it is best to measure the current consumption at two voltages. Thus, for a factory-built receiver, it would be necessary to know what current is consumed at a measured line voltage such as at 110 or 115 volts. In custom-built receivers, it is usually an easier matter to obtain readings at varying voltages and it would be well to obtain the current reading at, say, 90 volts and 110 volts. This information would immediately identify the proper control unit for use with a particular receiver. It can be readily understood that a universal automatic line voltage control to cover the varying current consumption of all radio receivers is not possible. A line control unit must be accurately designed to handle the particular currents involved and unless it is so designed, the degree of control obtained is entirely insufficient.

A Simple Approach

It is rather simple to consider the line voltage control problem from the following point of view. Assume a definite line voltage, such as for example 110 volts, at which your receiver is designed to operate at its very best. Above and below this line voltage, there is a narrow range of plus or minus 5 per cent. or between 105 and 115 volts in which range your receiver functions properly and the tubes operate within their rated limits. If your voltage operates above this range, your set is subject to distortion, premature burn-outs, blasting and noises. If your set operates below the above range, it is subject to fading, insufficient volume, loss of sensitivity and crystallization of tube filament, which likewise cause tube breakdowns. The line voltage control unit which functions properly must maintain the voltage delivered to the set within the narrow range explained above irrespective of line voltage fluctuations.

(*Continued on page* 90)

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for June-July

Several choice glider articles covering every phase of this popular art are to be found in the June-July issue.

Capt. Robert A. Smith, Manager of Fairchild Aerial Surveys, Inc., tells most interestingly of the troubles that beset the pioneer aerial photographers, taking us through the war days right up to the present.

"Vacations in the Air" carries its own appeal, and inasmuch as this was written by Capt. Frank M. Hawkes, holder of both the west to east and east to west trans-continental air records, it may be depended upon that this story is good.

Capt. Lewis A. Yancey, of trans-Atlantic flight fame, has gone thoroughly into the elements of flying meteorology, and when we have an expert to diagnose weather, the chances are that the reader will learn something about it.

And "Dawn Patrol"—a true story of the Royal Flying Corps in the war, simply takes the reader's breath away.

"The Aircraft Diesel Makes Its Bow"—the story of the development of the Packard Diesel, by Capt. L. M. Woolson.

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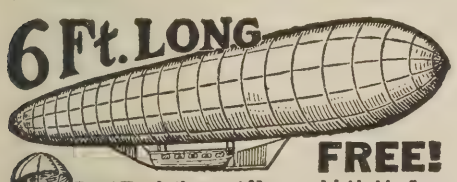

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Short-Wave Adapter

(*Continued from page* 41)

ground post of the set. And there you are.

The next article will deal with the operation and such construction do's and don'ts as may be necessary and, incidentally, there are very few of them.

The following parts are those actually employed in the construction of the short-wave adapter described here. Other parts, of similar electrical characteristics, may be substituted, but at the reader's risk.

C1, C2—National quicycle condensers, 125 mmfd.
C3—Aerovox condenser, .00025 mfd.
C4—Hammarlund equalizer, 35 mmfd.
C5—Aerovox condenser, .00025 mfd.
C6, C8, C9—Aerovox by-pass condenser, ½ mfd.
C7—Aerovox condenser, .01 mfd.
R1—Aerovox grid leak, 4 megs.
R2—Electrad Royalty variable resistance, 0-500,000 ohms.
L1, L2, L3—Set of four coils as described in Fig. 2.
R.F.C.—National choke, 90 henries.
L4—Coupling coil, pri. and sec. 3 turns each on ¾-inch core, coils separated ¼ inch, side by side.
Two National vernier dials, type E.
One National connector plug, 4 contact.
One Yaxley filament switch, No. 10.
Three Eby binding posts.
Four Eby sockets, 4-contact.
One National grid grip.
One main panel, 7 by 12 inches.
One sub-panel, 9 by 11 inches.
One box Corwico solid braidite.

Broadcast Receiver Trend

(*Continued from page* 24)

that dual selector circuit has been retained between antenna and first r.f. stage, while a single tuned circuit has been substituted interstage for the selector employed in the larger model. This results in somewhat decreased selectivity, as will be seen by comparison of Fig. 9 with Fig. 4, but which will be seen to be still somewhat greater than any receiver of the past season having a similar number of tuned circuits. In order to provide a product of greater simplicity and less cost, the automatic volume control has been eliminated and the volume is controlled completely manually by means of a potentiometer which shifts the screen-grid voltage on the first radio-frequency tube. Manual adjustment of tone bids for such popularity during the coming season that it has been retained on the smaller model. The audio-frequency channel duplicates that of the larger model and is its equal in every respect.

Both models are equipped for optional inclusion of standard Utah remote tuning unit. This unit permits a choice of nine pre-selected stations at a distance, as well as remote tuning by means of two buttons on the control box.

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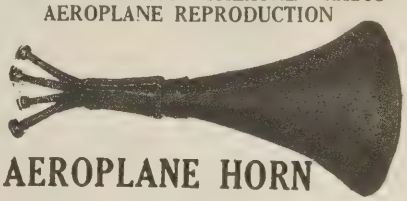

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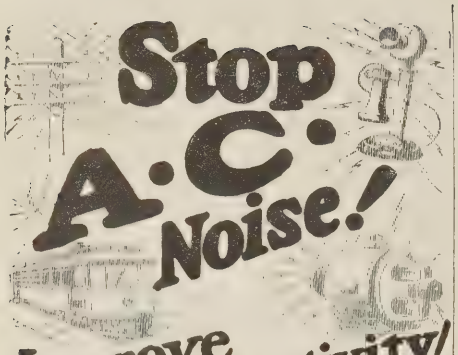

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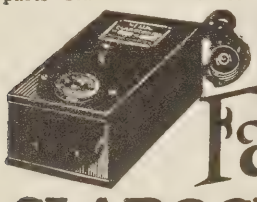

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Jobbers, Dealers and Set Builders

Write to us for further particulars.

CONTINENTAL WIRELESS SUPPLY CORP.

120 Liberty Street
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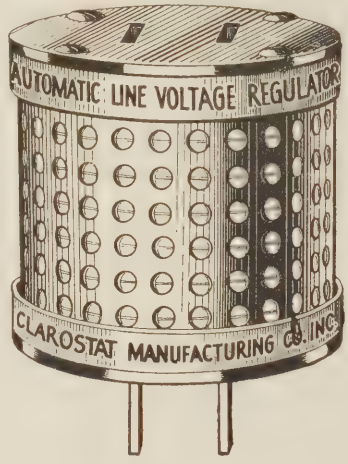
Line Voltage Regulators

(*Continued from page* 88)

Years of experience and research have definitely established the fact that the degree of control obtainable by means of the bulb type units described above is more accurate than can be obtained by any other means and yet the method of application is so simple that provision should be made for this line voltage control in every electric receiver operating on a.c. lines.

An Automatic Line Voltage Regulator Plug

For the purpose of providing the usual socket-power radio set with correct and uniform operating voltage at all times, in addition to protecting tubes and power pack from excessive voltage strains, the



Clarostat Mfg. Co., Inc., Brooklyn, New York, has developed the Automatic Line Voltage Regulator Clarostat. This device may be applied to any standard 110-volt radio receiver.

The device is in the form of a compact plug and receptacle for ready inclusion in the power line to the radio set, without tools or experience. The perforated metal shell contains the automatic resistance unit. The device is not a fixed resistor, nor again a resistor provided with taps for a variety of voltage conditions. Rather, it is an automatic ballast or self-compensating type of resistor, which offers high resistance to high line voltages, and very little resistance when the line voltage is at normal or even below normal, thereby maintaining the applied voltage at the proper and uniform level. Because of the special winding and free air circulation, the device is highly responsive to all voltage fluctuations. It acts as an r.f. choke in the line, reducing line noises. It serves as a safety fuse in the event of a short-circuit in the receiver. It is light and therefore remains placed in any receptacle.

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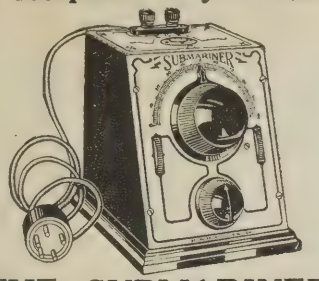

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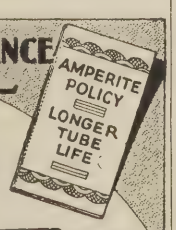

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Receiver Tone Control

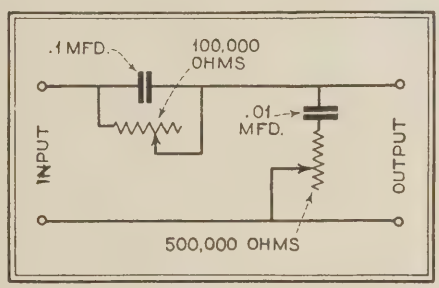
By Elmore B. Lyford

THE manufacturers of broadcast radio receivers are beginning to realize that it is impossible to build a receiver whose tone characteristics will completely satisfy everyone—even though the receiver may have the best audio amplifier that could possibly be designed, there would always be some who would not like it. This is only natural, for not only does the "hearing ability" of different people vary, but so also do their tastes. To some listeners very high notes produce something closely akin to physical pain, while to others the "boominess" of over-accentuated bass notes robs the program to which they are listening of all the enjoyment which it might otherwise afford.

Receiver Control

Only a few progressive manufacturers have, thus far, incorporated in their receivers any means for varying and controlling the tone of the instrument. With the others, or with any of the older receivers, the listener is forced to accept whatever tone characteristics the receiver has, and make the best of it. The tone control here described, however, may be assembled by anyone in a few minutes, attached to any receiver, and be used to regulate the quality of the set to any desired degree.

As may be seen from the accompanying schematic diagram, this tone control comprises in essentials two fixed condensers and two variable high resistances—nothing very complicated, but the results are all that could be asked. The whole action of the tone control depends upon the fact that a condenser offers a much greater



impedance, or blocking effect, to a low-frequency alternating current than it does to a high-frequency alternating current.

Condenser

Referring again to the diagram, we can see that the 0.1 mfd. condenser, which is in series with the circuit through the device, will offer a much larger impedance to low frequencies than to high, and by thus cutting them down will serve to accentuate the higher ones—make them more predominant in the loud speaker, and easier to hear. In similar fashion, the 0.01 mfd. condenser, which is shown in parallel with the circuit through the device, will "short out" and eliminate many more of the high frequencies than the low, and by so doing serve to accentuate the lower ones.

(*Continued on page* 95)

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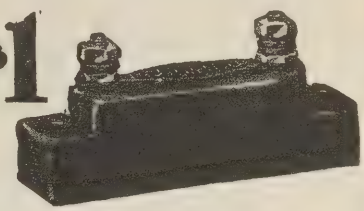

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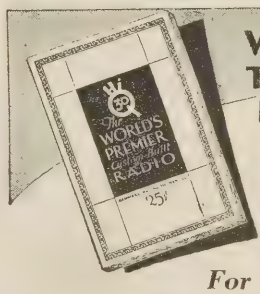

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.
Of RADIO NEWS, published monthly at Jamaica, N. Y., for April 1, 1930.

State of New York, } ss.
County of New York }

Before me, a Notary Public, in and for the State and county aforesaid, personally appeared Arthur H. Lynch, who, having been duly sworn according to law, deposes and says that he is the Editor of the RADIO NEWS and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, EXPERIMENTER PUBLICATIONS, INC., 381 Fourth Avenue, New York, N. Y.; Editor, Arthur H. Lynch, 381 Fourth Avenue, New York, N. Y.; Managing Editor, John B. Brennan, Jr., 381 Fourth Avenue, New York, N. Y.; Business Manager, H. K. Fly, 381 Fourth Avenue, New York, N. Y.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) EXPERIMENTER PUBLICATIONS, INC., 381 Fourth Avenue, New York, N. Y.; B. A. Mackinnon, 381 Fourth Avenue, New York, N. Y.; H. K. Fly, 381 Fourth Avenue, New York, N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

ARTHUR H. LYNCH, Editor

Sworn to and subscribed before me this 17th day of March, 1930.
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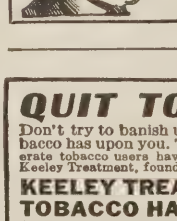

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Remote Control Systems

(*Continued from page* 43)

impedance is twice that of a single speaker. On the other hand, when two speakers are connected in parallel their total impedance is half that of a single speaker. Thus, if we have a group of four speakers wired in two pairs, the speakers in each pair being connected in a series, and the pairs being connected in parallel, the total impedance of the group will be equal to that of a single speaker, and will operate directly from the output of a receiver designed to work into a single magnetic speaker. This also applies where several dynamic speakers are worked out of a receiver designed for a single dynamic.

Where it is desired to work several magnetic speakers from a receiver that has a built-in dynamic speaker, it is advisable to employ a special coupling transformer, the primary of which is connected in series with the voice coil of the dynamic speaker in the secondary circuit of the output transformer originally included in the receiver. The magnetic speakers are then all connected in parallel in the secondary circuit of the new transformer. For this purpose the primary of the special coupling transformer should have an impedance equivalent to that of a dynamic speaker and a secondary impedance approximately equal to the total impedance of the group of magnetic speakers. Special output transformers of this type are available with several taps taken off the secondaries to provide different impedance values. It is suggested that wherever possible the speakers of a system be connected in parallel. Where a series connection is used the breakdown of one speaker means that all speakers in the series will be affected, whereas in parallel connections a burned-out winding in one speaker will not affect the others.

The speakers themselves may be of any desired type, although for average use in individual rooms magnetic speakers are to be preferred because of their low power requirements and because they require no a.c. field supply. If desired, the magnetic speakers may be built into the walls. Speakers for this purpose are now being manufactured and usually consist of a small cone enclosed within a metal box with a grille front. The speakers are set into the wall with the grille front flush with the wall surface. Some of these units consist of a speaker alone, while others have a volume control and an on-off switch mounted directly on the front of the grille.

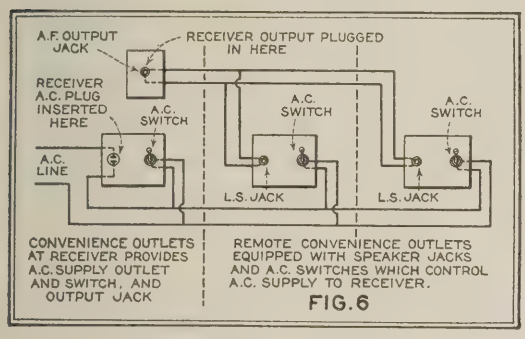
The wiring system is of course an important feature of the multiple loud speaker installation in the home. For the form of installation that consists only of several loud speakers distributed around the house, perhaps with an on-off switch and volume control for each, the wiring is, of course, simple. In existing homes, the owner may prefer to tack the wiring along the baseboards and picture molding, but obviously this is not a desirable method because it is impossible to conceal more than a small part of the wiring.

(*Continued on page* 93)

Practical Remote Control Systems

(*Continued from page 92*)

A more practical plan is to have an electrician run the wiring within the walls. For this purpose flexible metal-clad cables are usually employed and are "fished" through the walls, an operation that is far less difficult than the average person realizes. The difficulty involved varies with the type of wall construction employed in the house. In some cases all of the "fishing" can be accomplished through the holes which are cut in the walls to accommodate the radio convenience outlets. In other cases, it is necessary to break through the plaster at other points, but this can frequently be done in a closet or other out-of-the-way place, where the repaired plaster will not be conspicuous. In still other cases the work can be done by removing one or two floorboards and working through the opening thus provided.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REMOTE CONVENIENCE OUTLETS EQUIPPED WITH SPEAKER JACKS AND A.C. SWITCHES WHICH CONTROL A.C. SUPPLY TO RECEIVER.
FIG. 6

Fig. 6. This circuit provides for remote control of the receiver a.c. supply so that the receiver can be turned off at night from the bedside and turned on in the morning for the setting-up exercises.

Where the wiring system is to be installed during the construction of a house, rigid metal conduit provides the ideal wire-way. Not only does this type of conduit provide the maximum physical protection to the wiring, but in addition it serves as a complete electromagnetic shield to prevent pick-up of a.c. hum or other electrical disturbances. Furthermore, where rigid conduit is employed additional circuits may be run through the conduit at a later date or any desired changes may be made in the existing circuit without the necessity of breaking through the plaster to gain access to the wiring. This ideal wire-way is, of course, somewhat more expensive to install than the inferior types, but it is an interesting fact that in practically all of the large hotel, hospital and school radio installations, rigid conduit is used for all of the loud speaker distribution wiring.

The extent of the wiring required will depend on the type of installation. For the simpler systems that do not involve remote control the wiring is simply the equivalent of loud speaker extension cords, and any number of these wires may be run within a single conduit, either of the flexible or rigid type. Where a remote control system is employed its wiring should not be included in the same conduit with the loud speaker wiring.

The question of radio convenience outlets is one worthy of careful study. Outlets now available vary greatly and types are available for almost every requirement. The simplest form consists merely of a single jack mounted on a plate similar to the ordinary wall switch plate. Others include, in addition to the jack, a volume control and perhaps an on-off switch. Some, intended primarily for use with built-in speakers, do not have a jack. The manufacturers of remote control equipment provide convenience outlets suited to their circuits. Some outlet plates are also provided with a.c. outlets, a.c. switches, antenna and ground jacks, impedance units so arranged that when the loud speaker is turned off, impedance equivalent to that of the loud speaker is automatically cut into the circuit so that the volume level is maintained constant in all of the other speakers of the system.

The accompanying illustrations show typical circuits for permanent home radio systems. They will provide a good idea of the general plans involved and will be of assistance to home owners in planning their own distribution systems. The more complicated systems involving remote tuning control, etc., have not been shown because circuits vary according to the type of remote control. Circuits for each type can be obtained direct from manufacturers.

On Short Waves

Short Wave Editor,
RADIO NEWS.
Sir:

Have built the Junk Box receiver as an adapter for my four-tube set, using –99 tubes with a –20 tube output into a Western Electric Cone. To those who say –99 tubes are no good for this purpose I would say that the tubes be tried again. For the twelve-meter coil the form used was an old tube base and three turns were wound for the grid portion. With this coil I have had absolutely smooth oscillation, using no choke coil in the plate circuit. It appears that the transformer produces the necessary choking effect for proper regeneration. Several times I have had GBT audible over the entire house, also several others on the cone, such as PCJ, PCL, PHI, 2-ME, DF, CZ, CF, RX, KGO.

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"Sailing Craft of the Air"—Augustus Post, our Aviation Editor, describes the various gliders on the market.

"How to Build a SCOUT Secondary Glider"—the first installment in our secondary glider series by Lieutenant H. A. Reynolds, who constructed our Primary Glider, and Herr Martin H. Schempp, the well-known German glider expert.

"Flashes from the Radio Lab"—our monthly helpful hints for the home radio experimenter and fan.

"Master of the Whirlwind"—Alfred M. Caddell interviews Charles Lanier Lawrance, builder of the radial motor used by Byrd and Lindbergh.

"As Simple as A-B-C"—Count Mirzaoff gives a scientific history of our alphabet.

Several How-to-Make-Its, among them: How to Make Your Own Fireworks, How to Make an Outboard Aquaplane, How to Make a Garden Swing, How to Make a Newspaper or Stationery Rack . . . Physical and Chemical experiments.

Receiver Tone-Control

(*Continued from page* 91)

The two variable resistances which are shown in the circuit are for the purpose of adjusting the effect of these condensers until a pleasing balance has been affected. The variable resistance which shunts the 0.1 mfd. condenser may be of any value around 100,000 ohms, and the variable resistance shown in series with the 0.01 mfd. condenser should be as large as possible—preferably 500,000 ohms or more, so that when entirely open its condenser will be for all practical purposes entirely out of the circuit.

The Four Horsemen—S'sh, It's Polo

And no hay-wire game either—if four more horses for the opposing team and gentlemen who can stay on them can be obtained in advance of the Radio Show at Atlantic City. The gladiatorial combat will be housed in a riding academy at the seashore resort. Free tickets will be distributed at the Silver-Marshall booth. The challenging equestrians, shown leaning on their croquet mallets, are all of Silver-Marshall. From the left they are Burton Browne, McMurdo Silver, William Halligan and Lawrence Chambers. Their erstwhile opponents may be Sam Cohen, Herman Hollander, John Griffen and—a couple more s'sh's—The Headless Horseman of Sleepy Hollow. Mr. Headless is being invited, in spite of that fact, for the very good reason that he has a horse.

TELEVISION STATION SCHEDULES

Station	Owner	Wave-length in Meters	Power	Time Schedule	Holes in Disc.	Motor Speed	Subjects Televised
W1XAV	Shortwave & Television Laboratories, Inc., Boston, Mass.	137	½ Kw.	3 to 5 PM and 7 to 11 PM Daily except Sunday	48 Clockwise	900 R.P.M.	Halftones only
W2XBS	Radio Corp. of America New York City	142.8	½ Kw.	7 to 10 PM Daily except Sundays	60 Clockwise	900 R.P.M.	Not fixed
W2XCW	General Electric Company South Schenectady, N. Y.	139.5	20 Kw.		48 Clockwise		
W2XCR	Jenkins Television Corp. Jersey City, N. J.	139.5	5 Kw.	3 to 5 PM and 8 to 10 PM Daily except Sundays	48 Clockwise	900 R.P.M.	Silhouette films, halftones and living subjects
W2XR	Radio Pictures, Inc. New York City	139	¼ Kw.	4 to 6:30 PM and 7:30 to 10 PM Daily except Sundays and holidays	48 Clockwise	900 R.P.M.	Special film stories
W2XBU	Harold E. Smith Beacon, N. Y.	150		1 to 2 PM daily	24 Clockwise	900 R.P.M.	Living subjects
W3XK	Jenkins Laboratories Washington, D. C.	103 147	1¼ Kw.	8 to 10 PM daily except Sunday	48 Clockwise	900 R.P.M.	Silhouettes
W9XAO	Western Television Corp. Chicago, Ill.	153		2 to 3 PM and one hour every evening, different time each night	45 Clockwise (Sonabria System)	900 R.P.M.	Living Subjects

The tabulated information presented above indicates some of the experimental stations which are now transmitting television signals. It must be remembered, however, that because of their experimental nature their time schedules, wavelength, power, motor speed, etc., may be changed from time to time. This data is presented only to aid the experimenter in locating and otherwise identifying the several television stations now operating.—*The Editors.*

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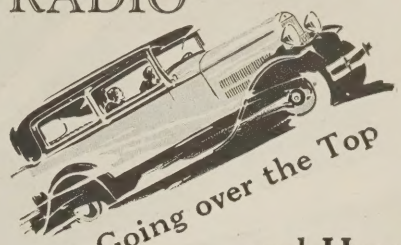

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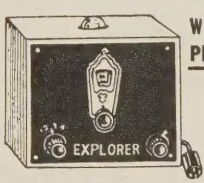

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Designed and manufactured by Electrad—pioneers in the introduction of a perfected Loftin-White Amplifier Kit. Licensed under Loftin-White and R. C. A. Patents. Tuner Kit $40.00, Amplifier Kit, $35.00 (Less Tubes).

Interesting, instructive literature on request to Dept. RN-7.

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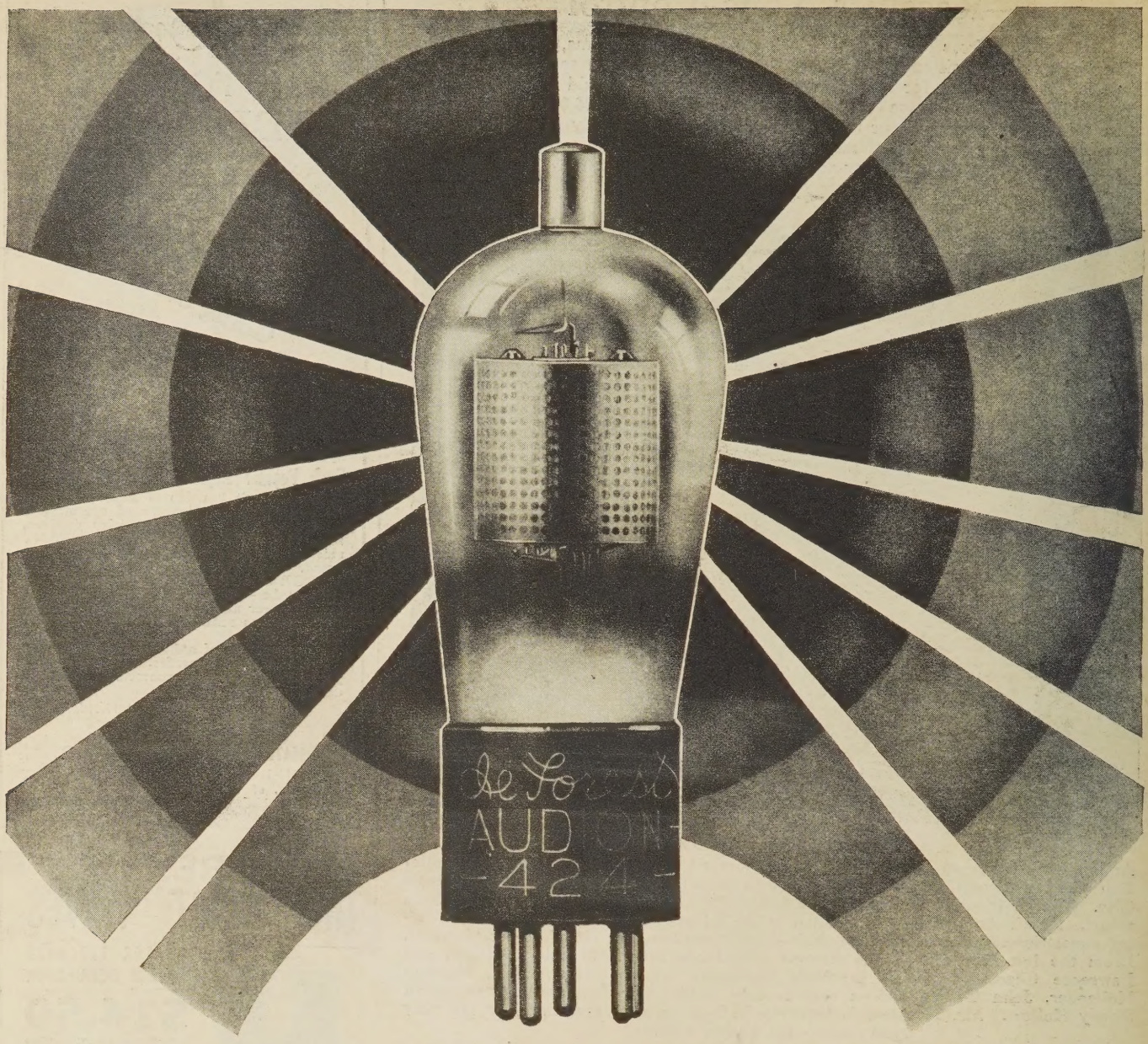
ELECTRAD INC.



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Single anode inverted type

The Pioneer

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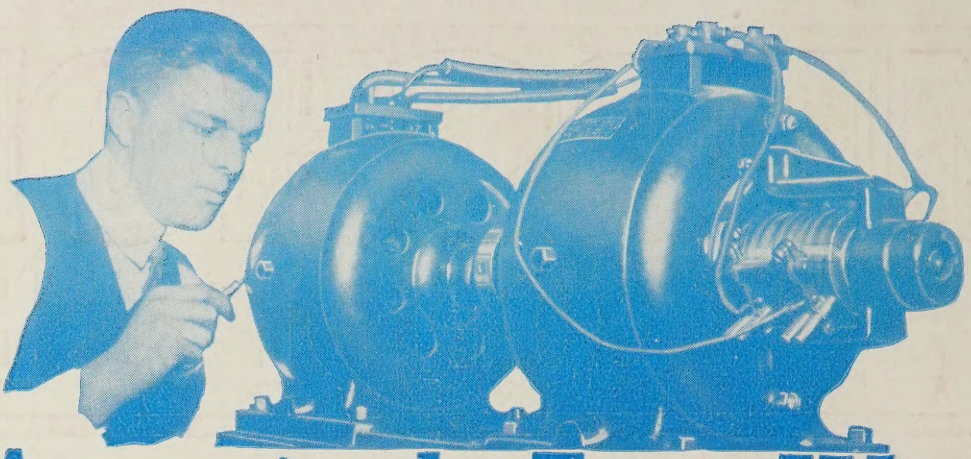

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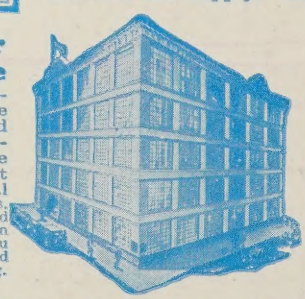

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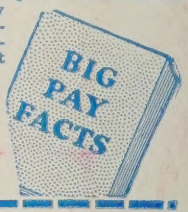

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